the OIL AND GAS JOURNAL

MAY 21, 1956

# ANNUAL NATURAL GAS & GAS PIPELINING NUMBER

How the Superhighway Plan Affects Oil p. 122

Now in Effect: Magnolia's Ultraengineered Flood p. 126

A.P.I. Hears Latest in Refining at Montreal p. 130

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Drilling Contractors Find Fault at Home. p. 136

# Why One Source for All Six?

Well completion is a joint effort. One thing leads to another, and each step requires close coordination. Isn't it better and easier for you to call in one good source for all six services than to coordinate the efforts of many "one-service" companies—especially since each will have a natural reason to emphasize its own contribution?

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# A Glance Ahead . . . . at press time

These trends will make TOMORROW'S NEWS

**A new wrinkle** in supplying positive displacement meters is to factory-calibrate a meter for a given oil for a given time. At the end of that time a spare is installed and the old meter sent back for recalibration. If the idea pans out, it's hoped that the calibrating tanks will be eliminated. Several counters on the meters allow running of more than one product through on a given calibration. Each counter would be set to act only on a particular product.

**Some offshore operators** are planning ultra-fancy communication systems to link permanent drilling-production platforms with onshore division headquarters. Included are channels for industrial TV so that experts on shore, for example, could be called on for major decisions on drilling problems. Applications have been made to the F.C.C., and one such system may go in this year.

**The tight oil-country pipe** situation is getting worse instead of better. Everything from 2 to 36-in. is being booked into 1958. Orders on some sizes slop over into '59. Veteran steel men can't remember anything like it.

Nickle steel, for vessels operating under extreme temperature and corrosion conditions, is almost "a thing of the past." The big drain here: defense projects. Even with expansion programs, steel men see little prospect for catching up so long as business remains good.

**Watch the rapidly-developing pre-Permian play** in Harper County, just east of the Oklahoma Panhandle. Nine discoveries in recent weeks in the Laverne district have sparked one of the busiest exploratory campaigns in northwestern Oklahoma since the big Beaver County play last year. Leases in the area are expiring soon, promising a fast drill-out program covering more than 20,000 acres. Ultimate recoveries may be more than $1 million per well on 640-acre gas spacing.

**Fear of reservoir damage** through hydraulic fracturing of water-flood producing wells is gradually being dispelled.

Many operators now are convinced fracturing is not only safe but that it increases the efficiency of the flood. Some contend it will even add to ultimate recovery. Operators are less certain about fracturing injection wells, but those who are trying it have seen no ill effects yet. They agree, however, that input-well treatments should be kept small.

**Surfactants are grabbing a bigger role** in fracturing. They're also getting attention as a substitute for fracturing. The idea is that there are many blocking effects of mud and water due to capillary surface forces not affected by fracturing. By changing the relationship of the oil, water, and rock to each other, it is believed that the agents will allow fractures to be created more effectively and that higher oil production, both into a fracture and into the well bore, will result.

The OIL AND GAS JOURNAL

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## NATURAL GAS—GAS PIPELINING

Supercharging by Tuning Engine Exhaust and Intake **148**
*By C. S. Kenworthy*
This is highly practical where the engine normally operates at a constant speed and can be brought up to full speed at a light load—as in the case of an a.c. generator.

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This long-distance single-line transmission system ranks among the biggest in initial and ultimate capacity.

Pacific Northwest Makes 3 Miles per Day **160**
*By Joe Reilly*
The 22 and 26-in. main line will start moving gas to Portland in about 2 months. Completion of the 1,500-mile main line is scheduled for late 1956.

Pacific Northwest Will Install 82,780 Compressor Horsepower **162**
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The compressors will be located in 13 mainline stations along the line running from the San Juan basin to Washington and Oregon.

Automotive Ignition System Works on Gas-Compressor Engines **166**
*By Aubrey E. Hinton*
Texas Gas Transmission Corp. has taken standard components used on automobiles and made them into a low-cost reliable ignition system for gas-compressor engines.

El Paso Starts Biggest Expansion Program **177**
*By Larry Resen*
The company's $195,000,000 expansion program will increase the system's capacity by 450 million cubic feet daily.

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The new unit is small, has short cycle, is fully automatic, and is self-contained.

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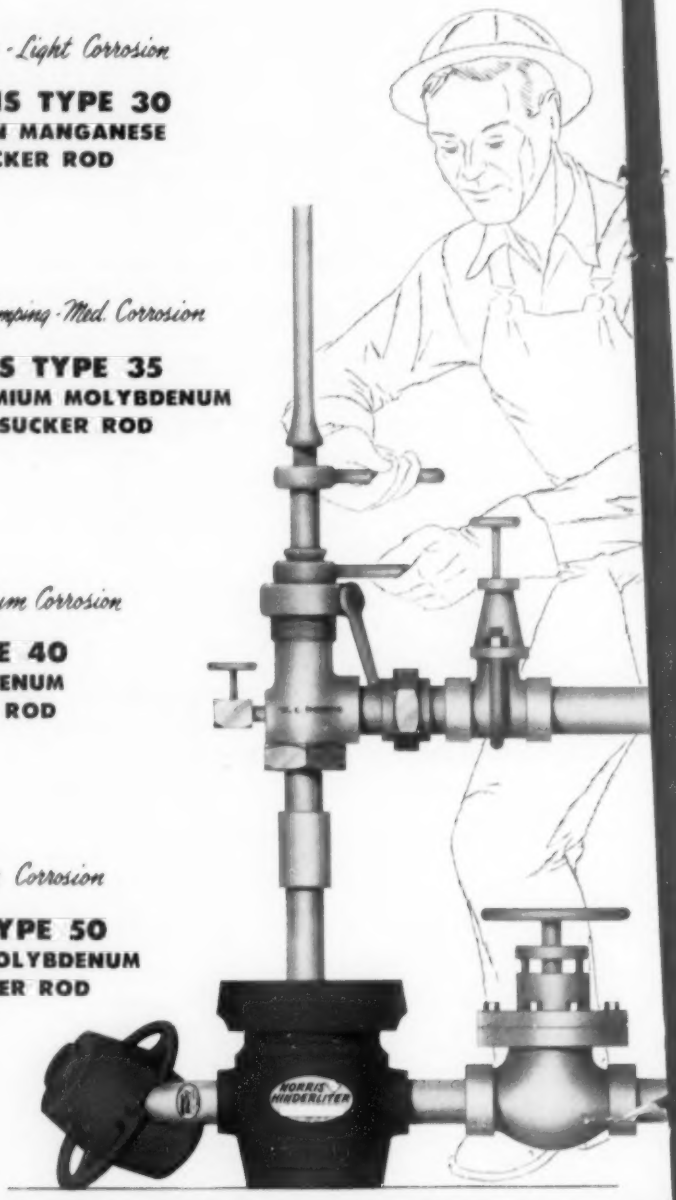


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Note the narrow width of these parallel compressors, powered by an in-line direct drive from the engine through right-angle, spiral-bevel gears.

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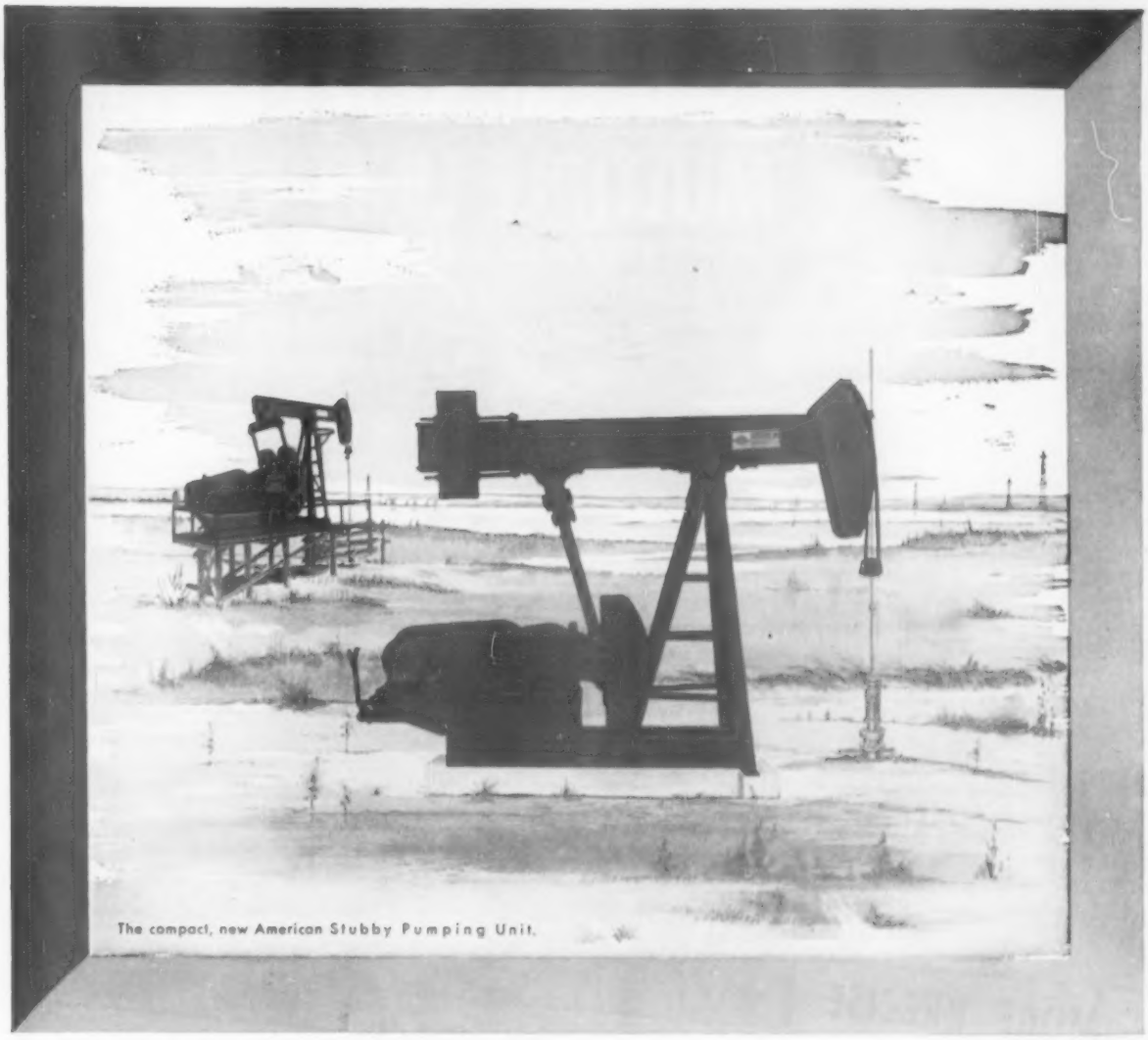

The compact, new American Stubby Pumping Unit.

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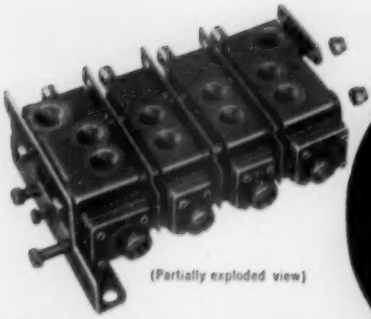

(Partially exploded view)

"O" ring seals between valve sections seal with pressure to form positively leak-proof joints.

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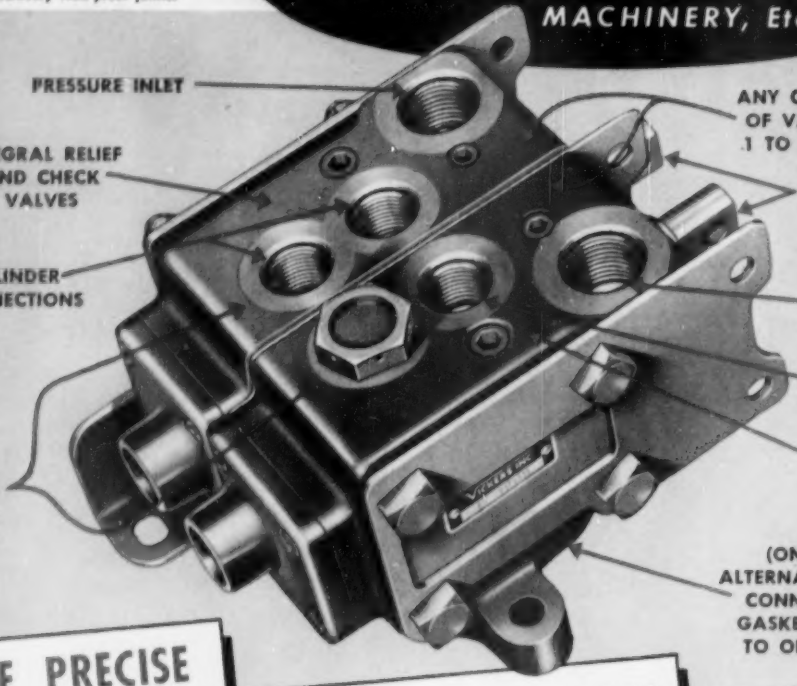
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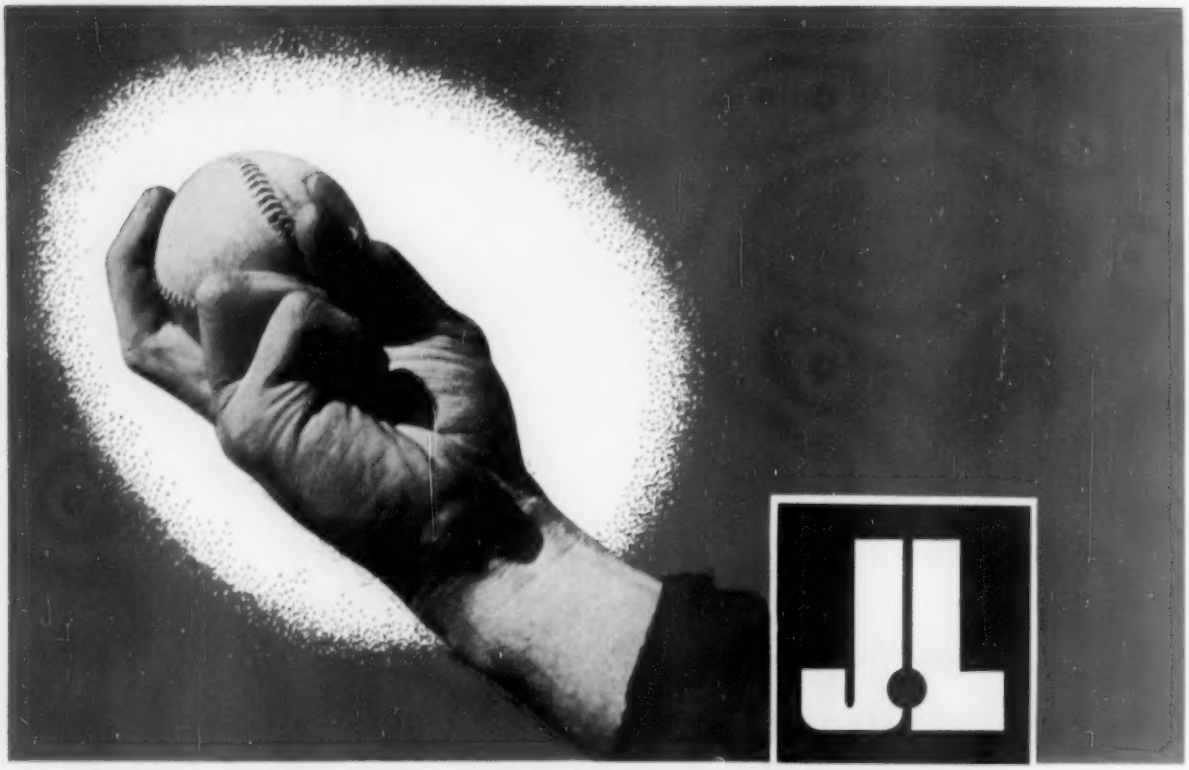

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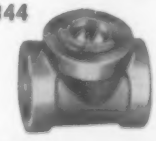
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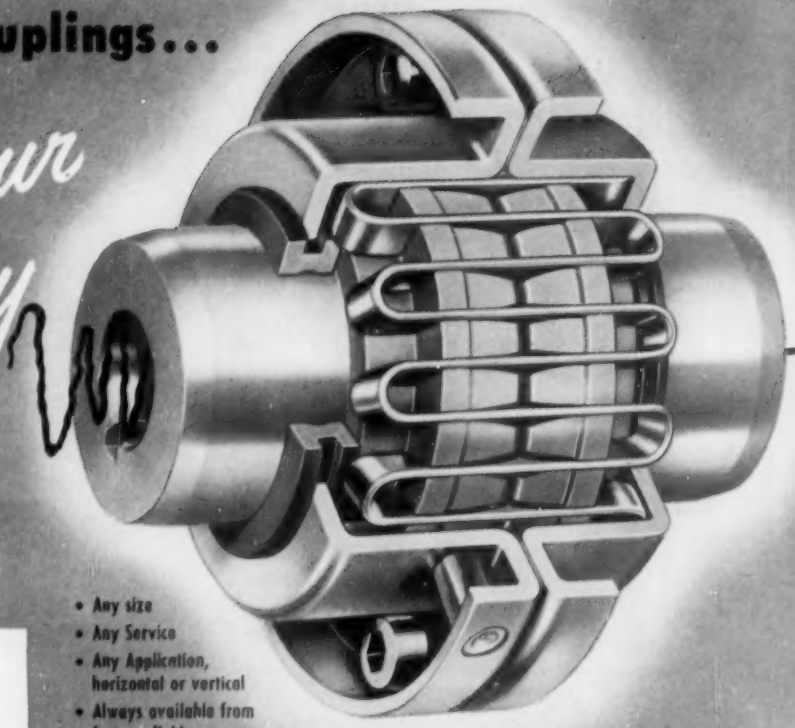

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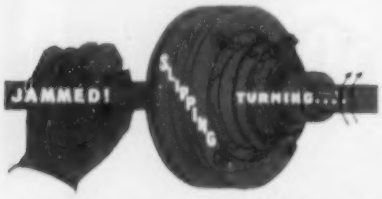
### Falk Controlled Torque Couplings prevent damage from overloads

In applications where danger from overloads exists, use the FALK Type FT Controlled Torque Coupling. The Type FT has all the features and advantages of standard FALK Steelflex couplings—and, in addition, has an adjustable friction slip clutch, enabling the operator to set the coupling to slip at any predetermined overload.

This controlled-torque principle not only prevents transmission of dangerous shocks and limits overloads; it eliminates the breaking of shafts caused by jamming of driven equipment.

An outstanding advantage of the Type FT Coupling is that, as soon as the cause of the overload is removed, the entire coupling will rotate and transmit power without replacing parts or repairing coupling.




There's real economy in using Type FT Controlled Torque Couplings. Many users have reported that these couplings paid for themselves the very first time they slipped (under overload) because of the protection against damaged driving or driven machinery!

## ...cost less per year of service!

You get *double protection* when you connect your driving and driven machinery with a Falk Steelflex Coupling—the all-steel coupling with the exclusive grid-groove design! First, its *torsional resilience* smothers shock and vibration; and second, the Steelflex design prevents damage and lowered efficiency by accommodating shaft misalignment.

Why have increasing numbers of key men in industry standardized on Falk Steelflex Couplings? Their experience has proved that Falk Steelflex Couplings prolong the service life of their machinery... are trouble-free and need minimum maintenance... are easy to install, lubricate and disconnect... and *cost less per year of service* than ordinary couplings.

One basic Steelflex design—the type F, in its many sizes—is adaptable to more than 90% of all industrial applications. For applications involving danger from overloads, Modified Type FT Controlled Torque couplings (see column at left) are ideally suited. There are numerous other special or dual purpose Steelflex couplings for unusual applications. **Write to Department 247** for engineering bulletin, including selection and dimension tables.

**THE FALK CORPORATION, MILWAUKEE, WISCONSIN**

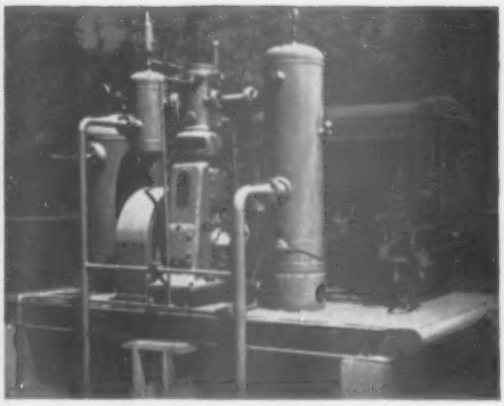
**FALK**

**...a good name in industry**

*MANUFACTURERS OF:*

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining

# THE ONLY MODERN-DESIGN COMPRESSORS FOR GAS BOOSTER OPERATION



Joy WGB-110 Gas Compressor. Inlet pressure 150 psig; Discharge pressure 500 psig. Capacity 1.028 MMCFD. "Packaged" by McNamar Boiler & Tank Co., Tulsa.

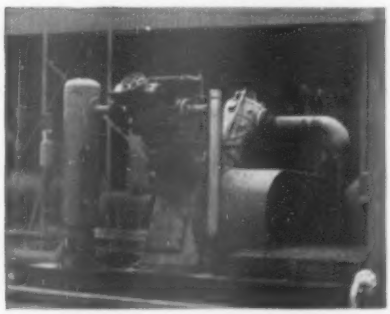
# JOY *Packaged* GAS COMPRESSORS

*Modern* Joy Packaged Gas Compressors are backed by a century-old reputation for low maintenance and long service. These *time-proved* features make Joy Compressors the most reliable for gas gathering, repressuring, or gas lifting:

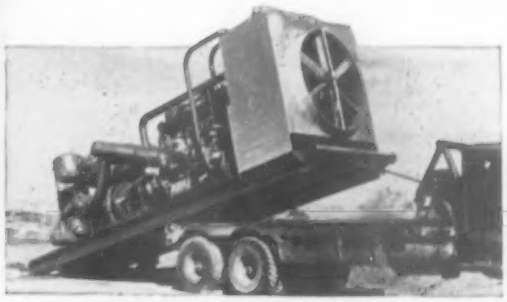
- **Field-replaceable cylinder liners.**
- **Field-replaceable crosshead guides.**
- **Patented Joy "Dual-Cushion" valves.**
- **Full force-feed lubrication.**
- **Anti-friction main bearings.**

Joy Gas Compressors are available in space-saving vertical, V-type, and semi-radial designs . . . single or two-stage units with cylinder sizes from 3" to 13½". Four different frame types accommodate a power range of 50 to 400 HP.

For the most efficient compressor for your needs, consult a Joy Engineer or write to ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*



Joy WNB-112 Gas Compressor. Inlet pressure 35 psia; Discharge pressure 665 psia. Capacity .85 MMCFD. "Packaged" by Oil & Gas Supply Company, Houston.



This photo of a Joy WNB-114 Gas Compressor Package being unloaded onto concrete pad clearly illustrates portability of unit. Inlet pressure is 5 psig; Discharge pressure is 150 psig. Capacity 2 MMCFD. "Packaged" by McNamar Boiler & Tank Co., Tulsa.

**Write for FREE Bulletin 84-31**

## Consult a Joy Engineer

FOR PORTABLE ROTARY DRILLS, AIR COMPRESSORS, GAS GATHERING COMPRESSORS, PORTABLE LIGHTING LINES

WSM 06054-84

**JOY**

**SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885**

Two More Pipeline Stations
NOW USING LOW COST
UTILITY ELECTRIC POWER!

Why? Because Utility Electric Power cuts down installation, operating, maintenance and labor costs. Convenient? You bet! With Utility Electric Power, you have constant, dependable service, remote automatic controls, and a smoother, more satisfactory, trouble-free operation.

Now's the time to check into Utility Electric Power for Your Power Needs.

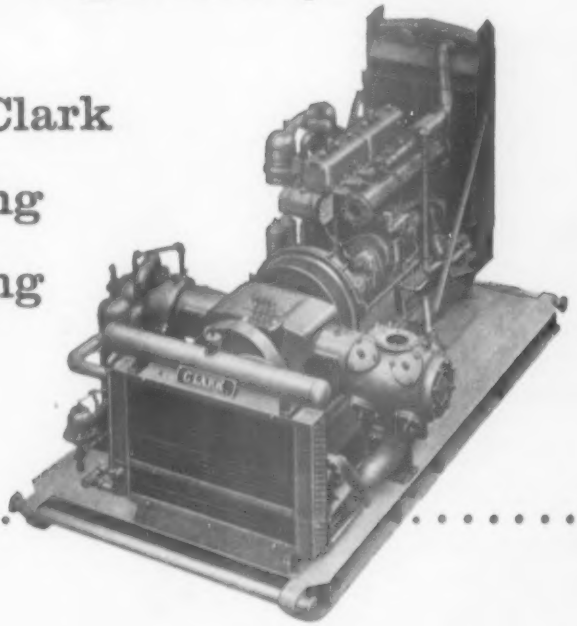
CALL YOUR LOCAL ELECTRIC UTILITY COMPANY FOR POWER FACTS

Petroleum Electric Power Association P. O. BOX 2771, DALLAS, TEXAS

ORGANIZED IN THE INTEREST OF GREATER SERVICE TO THE PETROLEUM INDUSTRY

# NOW...a compact 75-200 bhp Packaged Compressor

## Designed by Clark for gas lifting or gathering



**FEATURES**

**BALANCED/OPPOSED COMPRESSOR DESIGN**
Virtually vibrationless . . . a couple of yards of concrete will level it.

**DIRECT CONNECTED**
Eliminates belts or gear drives.

**ONE PIECE SKID**
Only 7' 3" x 15', rigid heavy "I" beam construction.

**CONSERVATIVE PISTON SPEED**
Lower than on most Clark stationary compressors.

**HEAVY DUTY RADIATOR**
Straight finned tubes. Easy to inspect or clean, inside or out.

**FACTORY ASSEMBLED AND TESTED**
No field assembly. Shipped as a complete unit.

**STANDARD ENGINE DESIGN**
Five makes of proved engine designs available.

**APPLICATIONS**
Use it for gas lifting, gas gathering, gas boosting, pipeline testing, recycle plant feeders, other field services.

You asked for this field compressor—as rugged, compact and perfectly balanced as the famed "Midget Angle" but of half the horsepower.

Now you have it, in the new Clark Model CFA. Rated at 75-200 bhp , this packaged unit is ideal for gas lifting or gathering.

The CFA uses a new specially designed 5" stroke Balanced/Opposed compressor directly connected to a standard design gas engine. The compressor and engine, together with radiator, scrubber, etc., are mounted on a rugged steel skid measuring only 7' 3" x 15'.

The CFA is virtually vibrationless in operation because of its Balanced/Opposed action. In most cases the small amount of concrete used to level the unit will provide ample support. Direct drive eliminates the need for cumbersome belts and gears.

Easily and speedily transported on an average size truck, this new field compressor can also be operated on truck or floating barge.

The CFA is factory assembled, tested and shipped as a complete unit. Because of standardization the CFA can be shipped from stock in most instances.

There is a Clark CFA specialist in your area to give you all the facts. If you require greater horsepower, ask him about the Clark HMA and HMAB.

**CLARK BROS. CO., OLEAN, N. Y.**
*ONE OF THE DRESSER INDUSTRIES*
Offices in Principal Cities Throughout the World

## CFA now on tour

—in Oklahoma, Kansas, Colorado, Texas and Louisiana.

Watch your newspaper for date and location of demonstration.

CLARK®

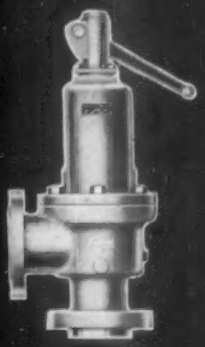
Packaged Compressors

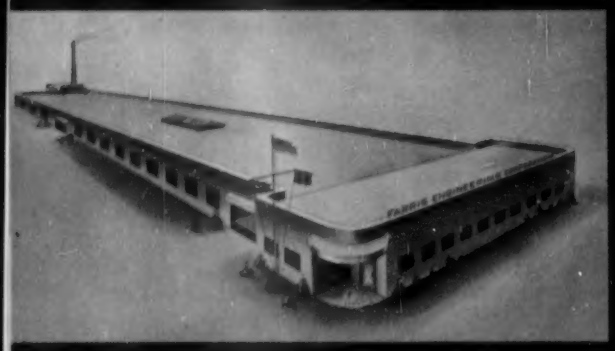
1943

# "Progress."

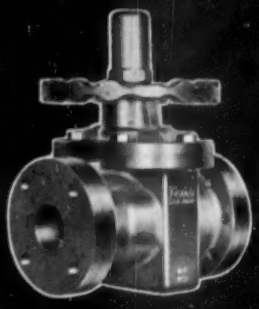
1944

Safety-Relief Valves
Balanseal Bellows Valves
Farris Engineering Corp.





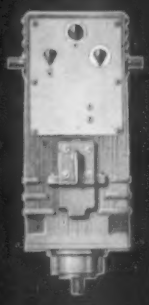
1945



Pinch Type Flexible
Diaphragm Disc and
SuperSeal Valves
Farris Flexible Valve Corp.

1951

Mechanical and
Hydraulic Governors
Farris Pickering
Governor Co., Inc.



U. S. Patents and Patents Pending

1955

# .. through honest purpose"

**The larger and more experienced a manufacturer becomes, the more he appreciates that PROGRESS is not restricted to simply producing fine products at fair prices. Rather, it is the sum total of all the services he renders to his customers day by day and year by year. It is unceasing vigilance to assure customer satisfaction . . . it is constant concern for improvement—for *better* products at even *better* prices . . . it is strict adherence to a commercial code of honor, like Farris' policy of "Progress—Through Honest Purpose".**

**Evidence of this policy's success is seen in the rapid and constant growth of the Farris organization. And even as you read this, more facilities are being added . . . designed to provide even greater service for users of Farris Safety and Relief Valves (which have set the pace in design and performance and have been duplicated by other manufacturers), Farris "SuperSeal" Flex Valves and Farris Pickering Governors.**

**Behind our continuing growth and the world-wide recognition of Farris as a pacesetter in its field, is the fundamental belief that "honesty of purpose" when dealing with people is always to be trusted. Upon this belief we have grown . . . and, because they believe in the same things, our customers and friends have supported us. Here, beyond doubt, is proof that the right way to grow is THROUGH HONEST PURPOSE.**

and HOUSTON, TEXAS **1955**

PROGRESS THROUGH Farris HONEST PURPOSE

## AFFILIATED COMPANIES

400 COMMERCIAL AVE., PALISADES PARK, N. J.

- Farris Engineering Corp.
- Farris Flexible Valve Corp.
- Farris Pickering Governor Co., Inc.
- Farris Hydrotorque Corp.
- Farris Hydroseal Corp.

## Protect them with New Pitt Chem

# TARSET®

RIGHT *now*—as you read this—corrosion may be destroying thousands of dollars worth of your petroleum handling and storage equipment. It happens every day, as witness the photograph of the crude oil storage tank top, above.

Now—for the first time—you *can* control these costly corrosion losses with a practical and relatively economical protective coating—new Pitt Chem "Tarset." This revolutionary new approach to crude oil corrosion combines the best qualities of two of industry's most effective and proven protective materials—*coal tar* and *epoxy resin.*

Tarset is the kind of a rugged, heavy duty coating you want. It will not shatter at —30°F or soften at 400°F. It is easy to apply by brush, spray or roller and adheres so well that it is almost impossible to remove from metal.

What's *your* crude oil corrosion problem? Our Pitt Chem engineers are ready to tackle it right now . . . and, if possible, come up with some dollar-saving answers for you. *Write or call us today!*

WSW 5066

COAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

# wells drilled with water-base mud

# UNBLOCKED IN HOURS

by

## HALLIBURTON'S

## MCA

MUD CLEANOUT AGENT

By now it's no secret. Some wells drilled with water-base mud or oil-in-water emulsion mud as the drilling fluid are disappointing producers. And the reason is frequently the intrusion of mud particles and fluid loss into the producing formations. Flow channels are blocked, particularly in bentonitic sands.

But now the good word: In many such wells, initial production has been high after treatment with Halliburton's Mud Cleanout Agent—"MCA"!

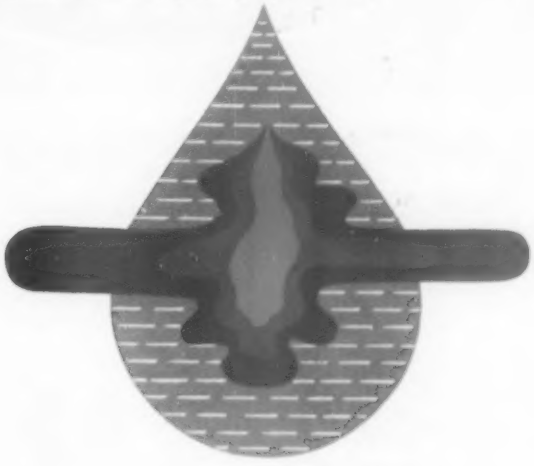
### *DOUBLE ACTION AGAINST BLOCKS*

With MCA you get a *double* action that explains the remarkable successes of this cleanout agent. MCA combines hydrochloric acid with Halliburton's Morflo, a highly active surfactant. The HCL shrinks bentonite and attacks filter cake. The Morflo disperses shrunken bentonite particles, softens filter cake for easy removal in fluid suspension. Fast, too. Only one to two hours required for MCA's efficient action.

### *SPECTACULAR PRODUCTION GAINS*

Besides its value for completing newly drilled wells, MCA has been used with outstanding success on many older wells. Examples: a previously non-producing well still flowed 100 barrels a day one month after treatment with MCA. A gas well estimated at 6.4 million cubic feet climbed to 20 million when treated.

Consult with Halliburton's trained field personnel on the uses of MCA to clean out plugged pay channels in old and new wells. Call your local or district office of the Halliburton Oil Well Cementing Company.



COMPLETE DATA SENT ON REQUEST

*Add This Valuable Information To Your Halliburton Service File*

## HALLIBURTON

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250 SERVICE CENTERS—JUST MINUTES AWAY FROM ANY RIG

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**CLARK**

CLARK BROS. CO., Olean, New York—Gas turbines, engines, and reciprocating, centrifugal and axial flow compressors — gas, steam, electric and diesel driven.

**DRESSER IDECO**

DRESSER-IDECO DIVISION, Columbus, Ohio — Radio and television broadcasting towers, steel buildings, aircraft hangars, mechanical parking garages, electric power substations.

**DRESSER MANUFACTURING DIVISION**

DRESSER MANUFACTURING DIVISION, Bradford, Pa. — Pipe line couplings, pipe repair sleeves and clamps, weldments, forgings, welding fittings, flanges, rings.

**IDECO**

IDECO, Dallas, Tex.—Hydrair and Power Rigs; Full-View Masts; Substructures; Single, Dual and Drive-In Rambler Rigs; Blocks, Swivels, Rotaries; Mud Pumps; Petroleum Equipment and Supplies.

**Magcobar.**

MAGNET COVE BARIUM CORP., Houston, Tex.—Magcobar and Magcogel drilling muds and other specialized oil well drilling fluids and chemicals.

**PACIFIC**

PACIFIC PUMPS, INC., Huntington Park, Calif. — Centrifugal pumps for refineries, power stations, pipelines, and chemical plants; plunger pumps for oilwells.

**ROOTS-CONNERSVILLE**

ROOTS-CONNERSVILLE BLOWER DIVISION, Connersville, Ind.— Rotary positive blowers, gas pumps, centrifugal blowers, exhausters, and positive displacement meters.

**Security**

SECURITY ENGINEERING DIVISION, Dallas, Tex., Whittier, Calif. — Rock bits, reamer rock bits and hole openers; reamers, casing scrapers and Neo-Red rubber stabilizers.

*Tomorrow's progress planned today*

# Look for this symbol

## ...it identifies all Dresser Companies and their products... it is your guarantee of the DRESSER *plus*+

You gain an important extra plus value every time you are served by any of the Dresser companies. This is the unique way Dresser operates to serve you better. Each Dresser company works independently to assure maximum individual attention to your specific needs . . . yet all are teamed together in a single organization to provide a group of research, engineering, and manufacturing services. From Dresser you obtain equipment based on the over-all experience of many companies in many industries.

As performance demands on equipment become increasingly greater, Dresser will continue to pace the technological changes in your field. You can count on the Dresser companies as major suppliers of equipment researched and developed to serve you better and meet your future needs.

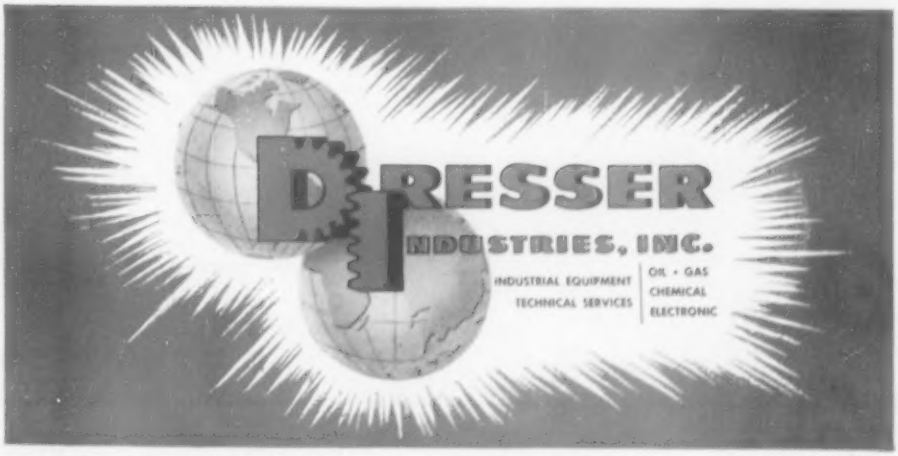
Wherever you are, whatever your needs, specify equipment from Dresser companies. No other single organization offers you the same broad range of "know-how" coupled with individual company attention to these specific needs. Be sure to look for this symbol – it's your guarantee of the Dresser *Plus*+ . . . the mark of superior equipment and services which have become the standard of comparison the world over.

LANE WELLS COMPANY

LANE-WELLS CO., Los Angeles, Calif., Houston, Tex., Oklahoma City, Okla.—Electric and Radioactivity Well Logging, Koneshot perforating and bullet perforating, packers and bridging plugs.

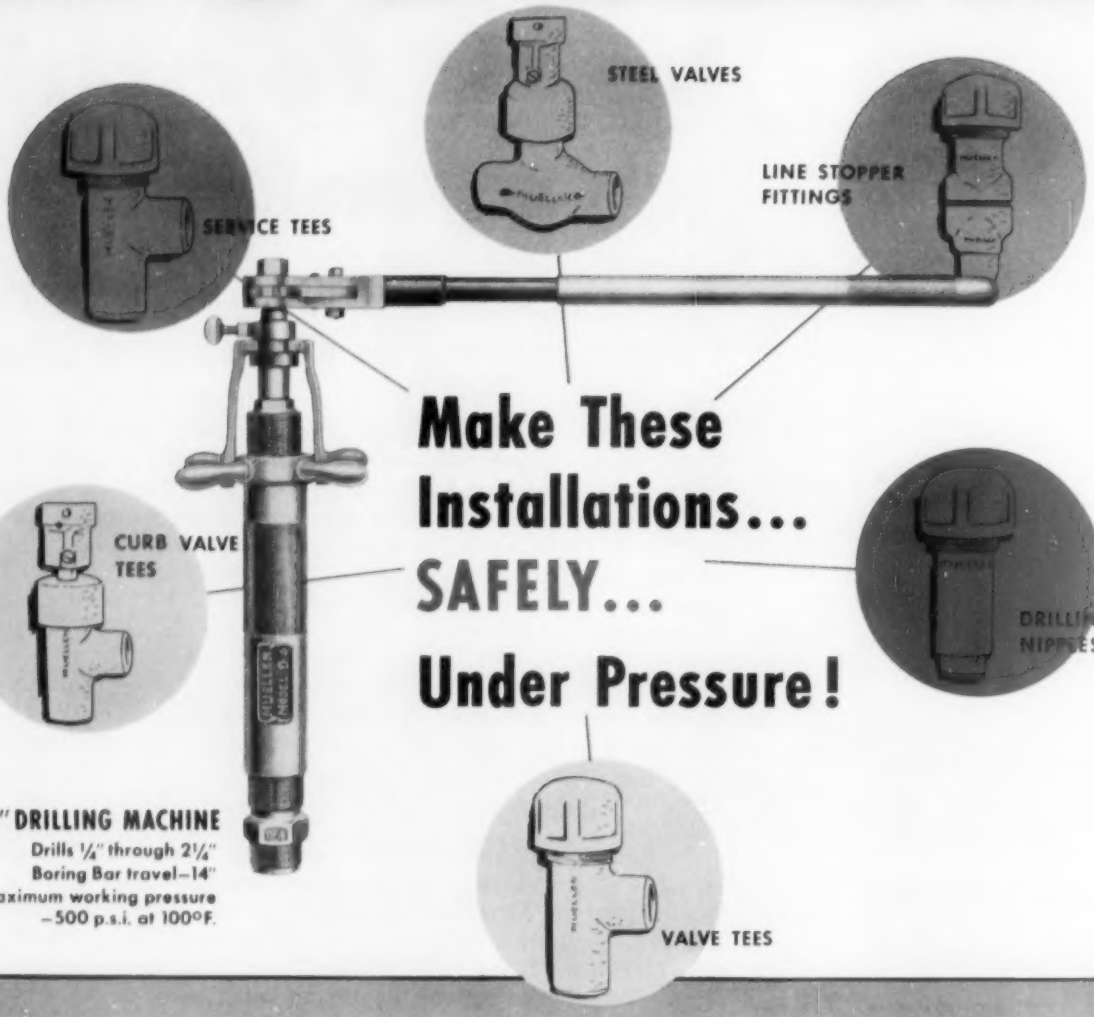
SIE

SOUTHWESTERN INDUSTRIAL ELECTRONICS, Houston, Tex.—Seismograph systems and instruments—electronic, electro-mechanical. Computers—analog and digital; recording systems. Special transformers, reactors.




REPUBLIC NATIONAL BANK BUILDING • POST OFFICE BOX 718 • DALLAS 21, TEXAS

# MUELLER®




## Make These Installations... SAFELY... Under Pressure!

**"D-4" DRILLING MACHINE**
Drills ¼" through 2¼"
Boring Bar travel—14"
Maximum working pressure —500 p.s.i. at 100°F.

NO-BLO®

*Contact your Mueller Representative or write direct for complete information on the complete line of Mueller No-Blo® products.*

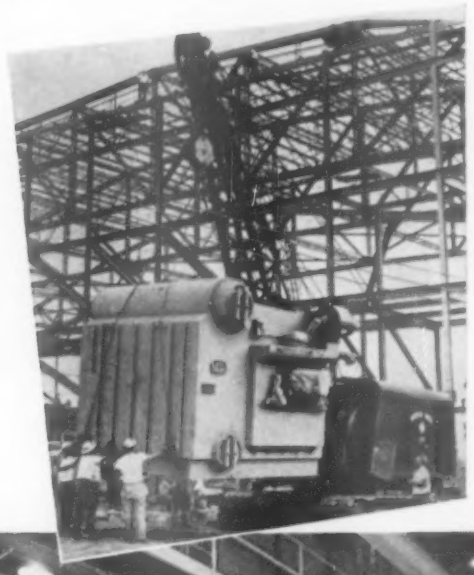
The Mueller "D-4" Drilling Machine can be used to activate any of these fittings. Holes ¼" through 2¼" can be drilled in any kind or size of main. Drilling operation may be done through a valve under full line pressure, with no blowing or interruption to other services on the line.

**MUELLER CO.**
Dependable Since 1857
MAIN OFFICE & FACTORY DECATUR, ILLINOIS

# Look for this honored Name Plate . . .

STEAM GENERATORS by Vogt

**a guide to advanced designs in package unit and custom built steam generating equipment**



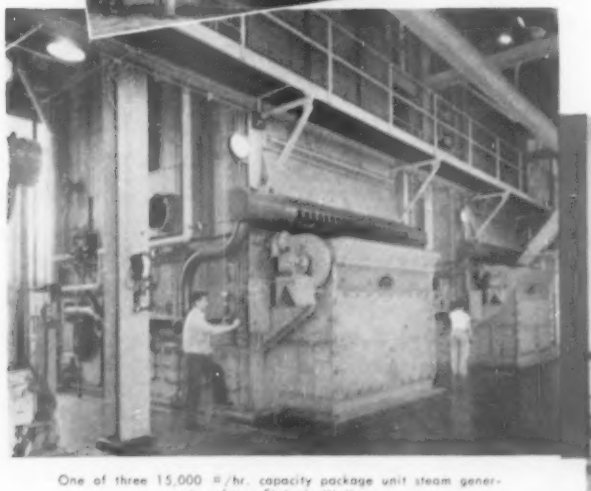
Vogt steam generating units are available in types and sizes to meet individual plant needs for power, processing or heating.

Package units range from 10,000 to 40,000 pounds of steam per hour while custom built units are obtainable in the larger capacities. Available in bent tube types and straight tube, forged steel sectional header types for solid, liquid or gaseous fuels burned singly or in combination.

*Write for Bulletins, Dept. 24-BO*

**HENRY VOGT MACHINE CO.**
Box 1918, Louisville 1, Kentucky

**SALES OFFICES**
New York, Chicago, Cleveland, Dallas, Philadelphia
St. Louis, Charleston, W. Va., Cincinnati, San Francisco



One of three 15,000 #/hr. capacity package unit steam generators for a State institution.

Two of three 41,000 #/hr. steam generators installed in Medical Center Steam Plant, Louisville, Ky.

Erecting two 50,000 #/hr. steam generators at Kelly Air Force Base, San Antonio, Texas.

**OTHER VOGT PRODUCTS**
Drop Forged Steel Valves, Fittings and Flanges in a complete range of sizes • Petroleum Refinery and Chemical Plant Equipment • Steam Generators • Heat Exchangers • Ice Making & Refrigerating Equipment

# 6 NORTHWESTS

Western Pipeline stretching from Williams to Oak Fork, Arizona. Six Northwests form a part of a fast moving spread.

# help make a fast moving spread!

Pullshovel work on a pipeline job may look easy but it takes stamina in both men and machines to stand up under the conditions that often develop. Heat, dust and dirt, and the wear and tear of miles of travel can be met profitably only by the best of equipment.

Northwest Pullshovels have been proved on miles of pipeline work. Northwest crawlers with their self-cleaning action stand up in the up and down hill travel. Easy steering gives smooth control in "leap frog" operations and in crossing and straddling ditch.

But most important of all is that outstanding ability of Northwests to always be ready to go with a digging ability to meet any condition. Simplicity of design makes them easy to care for. Adjustments are few and easily reached.

Ease of operation is assured by the "Feather-Touch" Clutch Control which utilizes the power of the engine to throw heavy drum clutches without resorting to delicate devices involving pumps or compressors. These things combine to deliver output that makes possible a fast moving spread.

These are the things that have put six Northwests on the Western Pipeline for Western Pipe Line, Inc., of Austin, Texas. A Northwest man will be glad to tell you all about it.

NORTHWEST ENGINEERING COMPANY
1517 Field Building • 135 South LaSalle Street
Chicago 3, Illinois

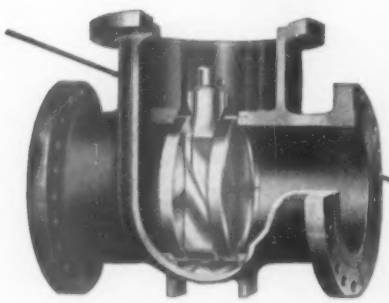
# NORTHWEST

CRAWLER and TRUCK MOUNTED SHOVELS • CRANES • DRAGLINES • PULLSHOVELS

PRODUCTION PLUS · $ · MEANS MONEY

P25-4-LCG

# LOOK INSIDE



## for dollars to be saved!

*Darling 24", Series 300, motor-operated gate valve, with fully revolving double disc feature, at pipe line terminal of oil pumping station.*

SURE! Other things being equal, it's definitely the inside of a gate valve that really tells the story. That's why we show and stress the importance to you of Darling's *fully revolving double disc, parallel seat principle!*

Simple construction, interchangeable no-pocket discs . . . yes . . . but that's only the start. This principle assures uniform distribution of disc-and-seat wear . . . coupled with Darling's unique wedging feature it once and for all licks the problem of faulty closure due to valve body distortion . . . and greatly eases operation even under the most adverse conditions.

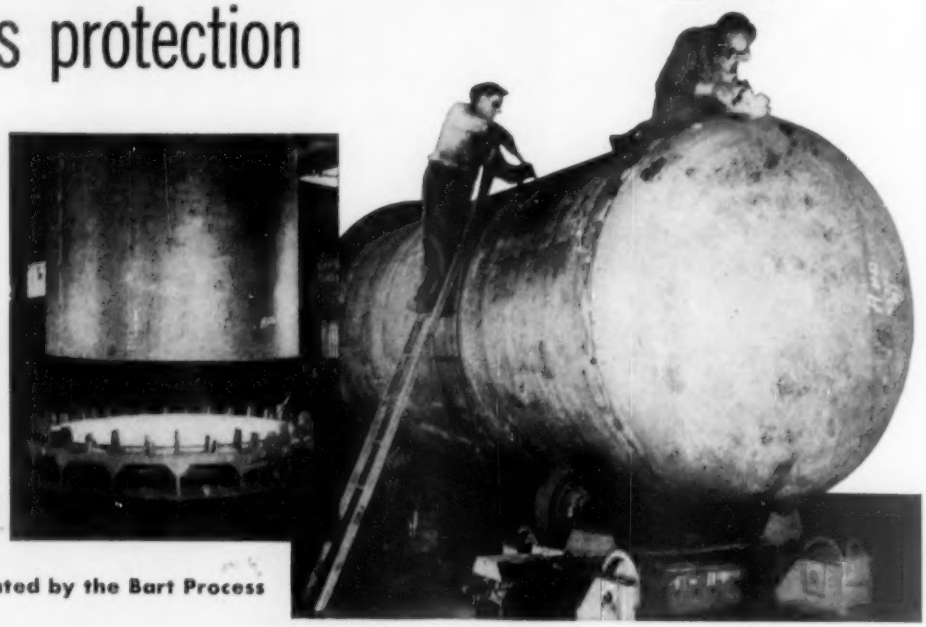
That's why oil and gas men everywhere have come to count on Darling gate valves for surer performance, longer life and less down time. It pays. We'll gladly give you *all* the facts on Darling valves for your particular operations. Just ask.

**DARLING VALVE & MANUFACTURING CO.**
**Williamsport 1, Pa.**

*Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.*

# CF&I LECTRO-CLAD* Trademark

## Nickel Plated Steel gives steel's economy plus nickel's protection



*Electroplated by the Bart Process

It's now possible to provide many products with low cost, sure protection against contamination and discoloration during processing, storage and transportation—thanks to CF&I LECTRO-CLAD Nickel Plated Steel!

For CF&I LECTRO-CLAD successfully combines the corrosion and contamination protection of nickel and the economy and strength of carbon steel. That's because this fully-proved product has a heavy layer of electrodeposited nickel that's 99% pure permanently bonded to the steel.

Ideally suited for heavy industrial applications where the rate of corrosion does not exceed 0.0015 inches per year, CF&I LECTRO-CLAD is customarily supplied with nickel plating in the 8-10 mil range; however, it can be plated up to 15-20 mils, if specified.

What's more, it's easy to fabricate. Just use regular shop equipment to bend it, weld it, roll it, etc.

See your nearby CF&I representative for the complete story on economical, effective, easy-to-fabricate CF&I LECTRO-CLAD Nickel Plated Steel. Or write Wickwire Spencer Steel Division, The Colorado Fuel and Iron Corporation, P.O. Box 1951, Wilmington, Delaware.

## CF&I Claymont Steel Products

*Products of Wickwire Spencer Steel Division • The Colorado Fuel and Iron Corporation*

Abilene (Tex.) • Albuquerque • Amarillo • Atlanta • Billings • Boise • Boston • Buffalo • Butte • Casper • Chicago • Denver • Detroit • El Paso • Ft. Worth • Houston • Lincoln • Los Angeles
New Orleans • New York • Oakland • Odessa • Oklahoma City • Philadelphia • Phoenix • Portland • Pueblo • Salt Lake City • San Francisco • Seattle • Spokane • Tulsa • Wichita
CANADIAN OFFICES AT: Toronto • Vancouver

3869

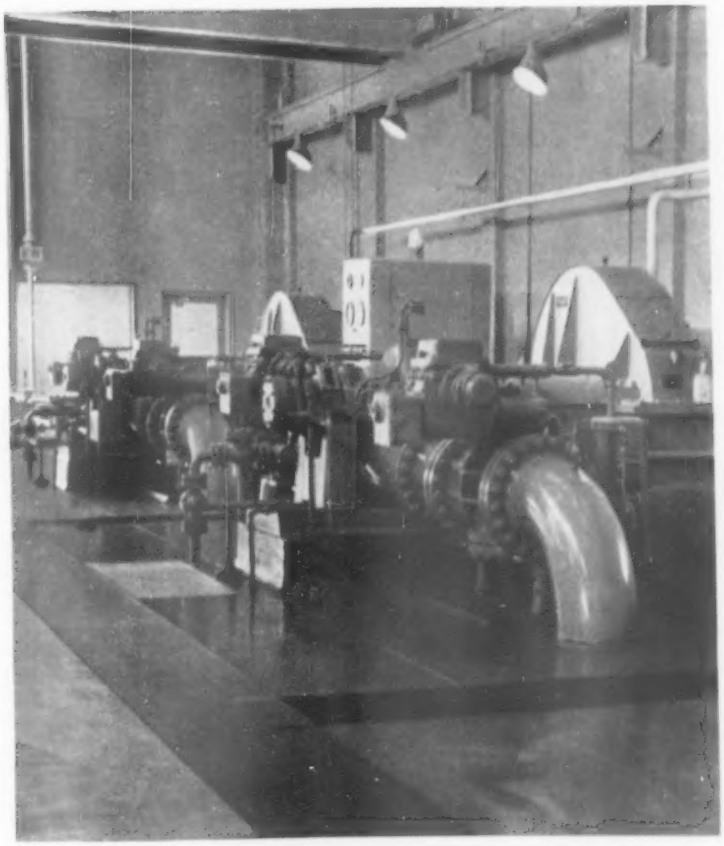
**OTHER CLAYMONT PRODUCTS**

**Stainless-Clad Plates • Manhole Fittings and Covers • Large Diameter Welded Steel Pipe • Flame Cut Steel Plate Shapes**
**Flanged and Dished Heads • Carbon and Alloy Steel Plates • High Strength Low Alloy Steel Plates**

Interprovincial-Lakehead pipe line — owned and operated in Canada by the Interprovincial Pipe Line Company, and in the United States by Lakehead Pipe Line Company. Transports heavy grade of crude oil. Rated capacity: western end, 185,000 barrels per day; eastern end, 105,000 barrels per day.

# WORLD'S LONGEST CRUDE OIL LINE

## served by 21 Farrel® speed increasers



Two of three Farrel speed increasers at Saxon (Wisconsin) pumping station.

The Interprovincial-Lakehead pipe line — longest crude oil line in the world — runs from the oil fields near Edmonton, Alberta, to the large Canadian refineries at Sarnia, Ontario. Nine Farrel speed increasers transmitting 1800 HP each and twelve others rated at 800 HP each, serve the pumping stations located in the United States.

The Saxon (Wisconsin) station, newest in the line, gets its pumping power from three 1760 BHP turbocharged Diesels driving centrifugal pumps through Farrel speed increasers. The gear units increase the 500 RPM engine speed to a pump speed of 3600 RPM.

Of the hundreds and hundreds of Farrel units installed throughout the world, not one has ever been replaced. Even the first units, built twenty-five years ago, are still in service. Next time you're in the market for speed increasers, remember the amazing record of Farrel units. It's a virtual guarantee of trouble-free performance.

**FARREL-BIRMINGHAM COMPANY, INC.**
**ANSONIA, CONNECTICUT**

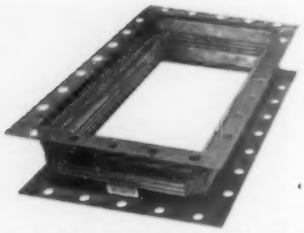
*Plants:* Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.

*Sales Offices:* Ansonia, Buffalo, New York, Boston, Akron, Detroit, Chicago, Minneapolis, Fayetteville (N. C.), Los Angeles, Salt Lake City

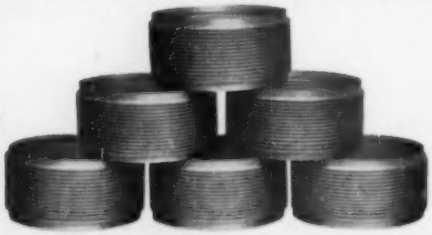
**Oil Field Representatives:**
Hercules-Lupfer Engine Sales Co., 124 N. Boston St., Tulsa 1, Okla.
V. W. Osborne, 860A M&M Bldg., Houston 2, Texas

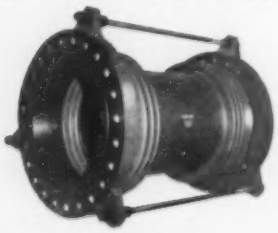
*Farrel-Birmingham*®

FB-1072

**Sola-Flex** **bellows** 

**and expansion joints**

**are made**  **in all sizes**

**and varieties** 

SOLA-FLEX JOINTS AND BELLOWS

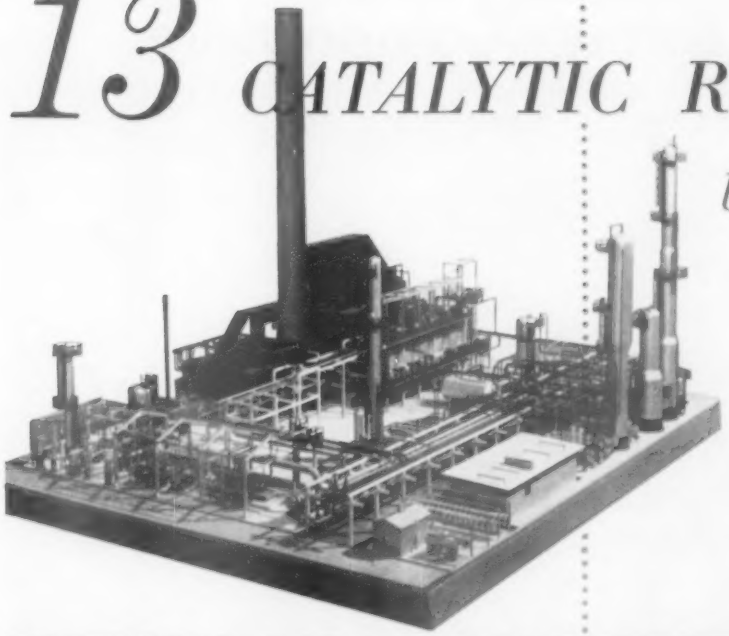
**BIG OR LITTLE,** round or square, convoluted or U-span—no matter what kind of expansion joints you need, Solar can build them. Sola-Flex joints are durable, economical, and are based on advanced engineering designs using a wide variety of metals. High or low pressure piping problems are easily solved with Sola-Flex bellows. Ask for our latest catalog. Write Dept. C-20, Solar Aircraft Company, San Diego 12, Calif.

**SOLAR**
AIRCRAFT COMPANY
SOLAR
SAN DIEGO DES MOINES

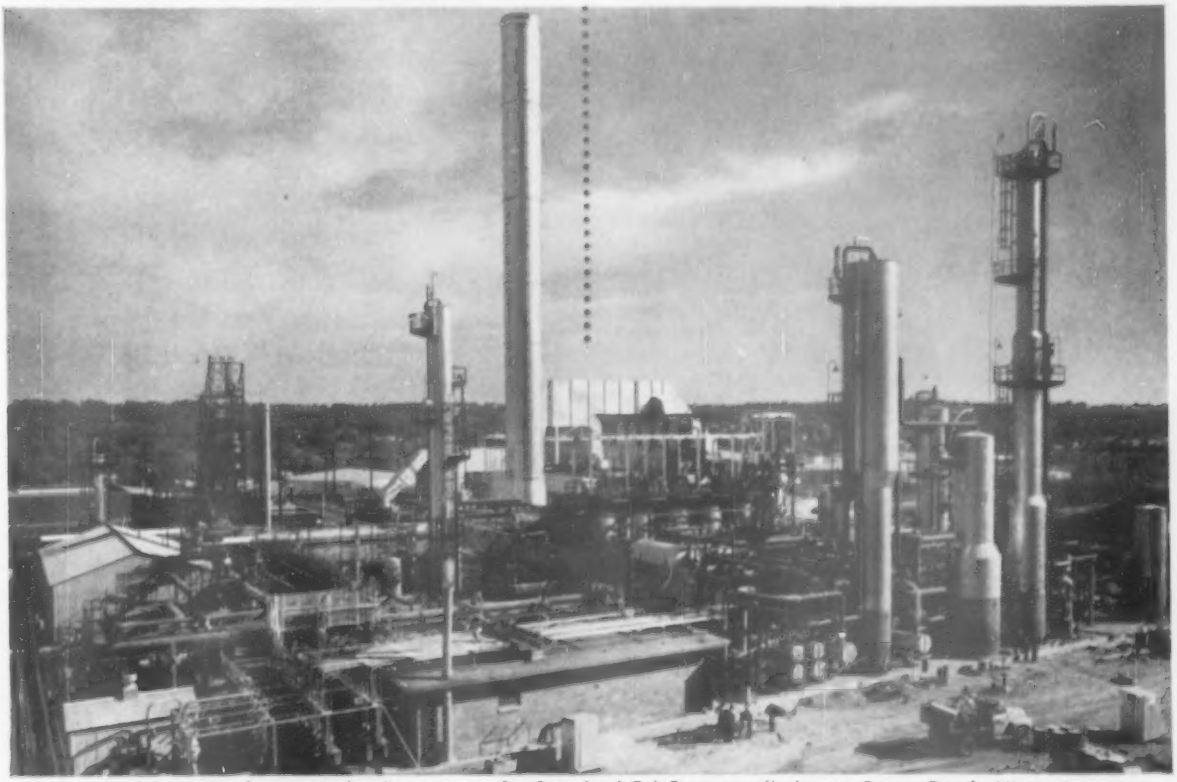
DESIGNERS, DEVELOPERS AND MANUFACTURERS OF METAL ALLOY PRODUCTS • GAS TURBINES • BELLOWS • CONTROLS • HIGH TEMPERATURE COATINGS • AIRCRAFT COMPONENTS

# 13 CATALYTIC REFORMERS

by PARSONS



**Contracts for thirteen catalytic reformers have been awarded to Parsons. These plants range in capacity from 600 to 21,000 barrels per day and include regenerative and non-regenerative units using four different platinum-type catalysts. Process design, engineering, procurement, and construction of these catalytic reformers are by Parsons.**



*Ultraformer Under Construction for Standard Oil Company (Indiana), Sugar Creek, Missouri.*

**THE RALPH M. PARSONS COMPANY**

NEW YORK
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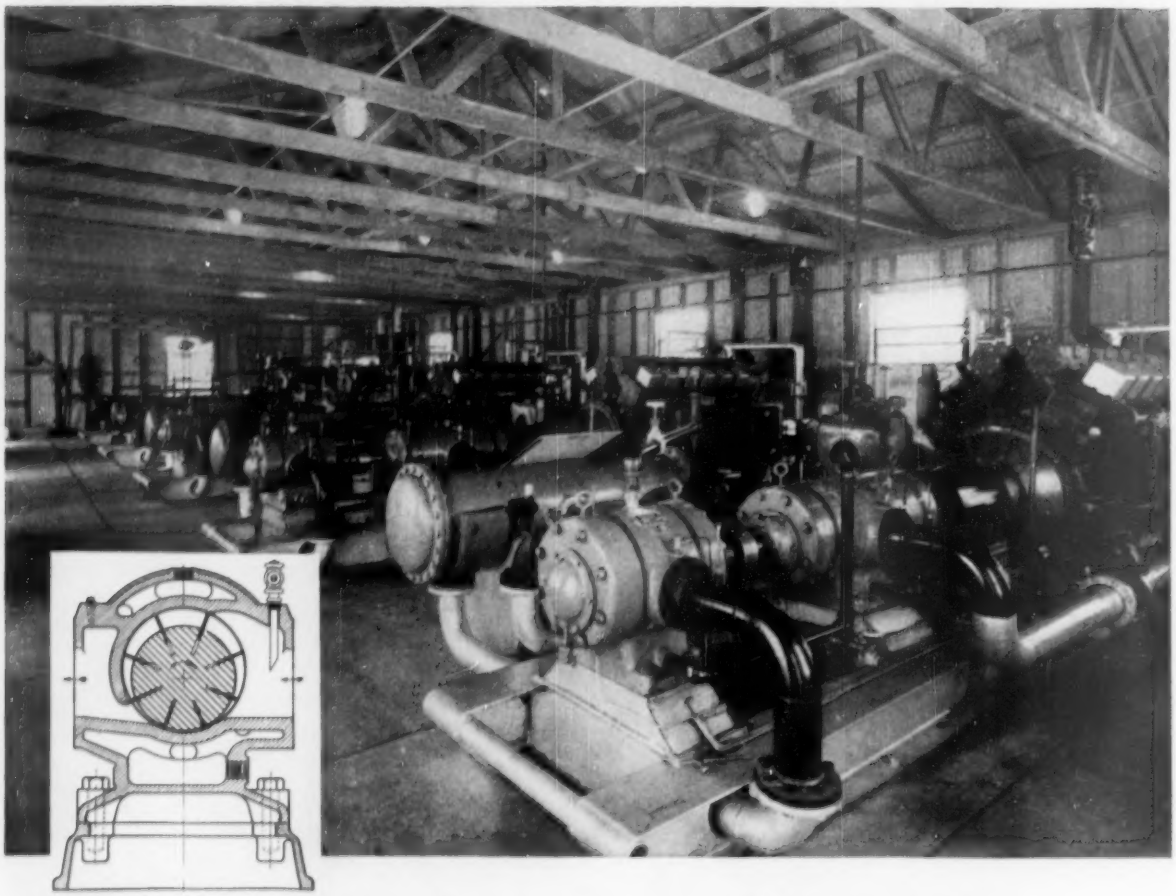
***ENGINEERS · CONSTRUCTORS***

**617 South Olive Street, Los Angeles 14, California**

# The "Inside" Story Of Fuller Rotary Compressors



Here, near Borger, Texas, is an installation of five two-stage Fuller Rotary Booster Compressors whose total capacity is 8,875,000 SCFD of casinghead gas compressing from 10 PSIG to 125 PSIG.

This same type of Fuller Rotary is used to boost gas into main booster stations and can be, and is, used where field pressures drop due to depletion. This latter use avoids expensive construction and increasing line sizes.

These, and other Fuller Rotary Compressors, now in widespread use throughout the petroleum industry, both indoors and out, incorporate trouble-free design that assures their dependability.

### SIMPLICITY

The elimination of compressor valves, crankshafts, pistons and numerous other moving parts greatly reduces the need for attention, adjustment and replacement.

### PULSATION—FREE FLOW

The smooth flow resulting from rotary compression eliminates pressure fluctuations and simplifies metering problems.

### SUSTAINED PERFORMANCE

The blades are held out by centrifugal force, automatically compensating for wear, thus maintaining new-machine efficiency and/or capacity.

### OPERATION WITHOUT VIBRATION

The rotary principle permits a compressor design completely free of reciprocating parts, thus avoiding the basic source of vibration.

The complete details, as well as sizes, of Fuller Rotary Compressors and Vacuum Pumps are available in Bulletin C-5A. We'd like you to have a copy. Send for it.

**FULLER COMPANY, 132 Bridge St., Catasauqua, Pa.**

SUBSIDIARY OF GENERAL AMERICAN TRANSPORTATION CORPORATION

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C-289
3026

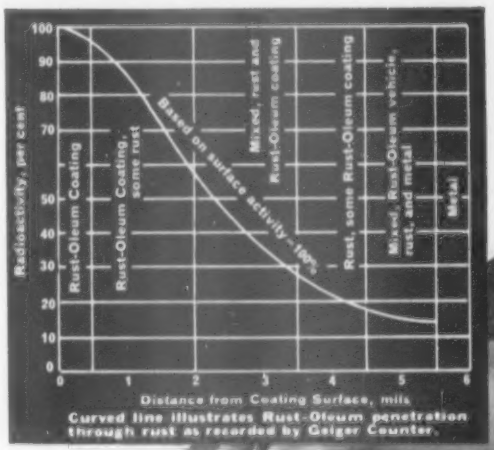
**PIONEERS OF HIGH-EFFICIENCY VANE TYPE ROTARY COMPRESSORS SINCE 1930**

# RUST-OLEUM®

# PENETRATION

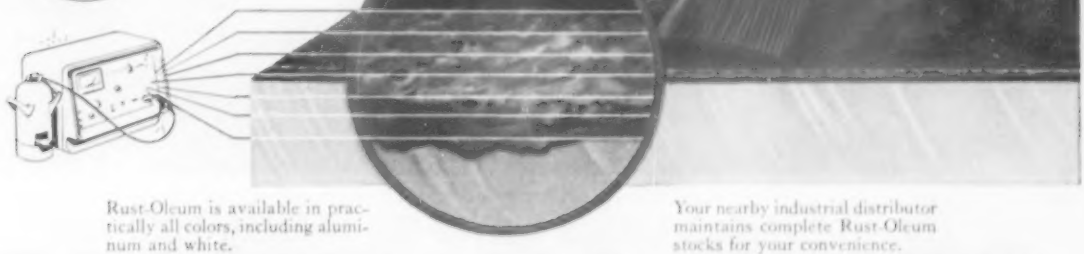
**through rust to bare metal traced by Geiger Counter.** To effectively stop rust—the vehicle of a protective coating, when applied over a sound, rusted surface—must penetrate through the rust down to bare metal. **Rust-Oleum does exactly that!—as proved by radioactive research!** Rust-Oleum's specially-processed fish oil vehicle was radio-activated and formulated into Rust-Oleum 769 Damp-Proof Red Primer—then applied to rusted test panels. Penetration *through rust* to bare metal by Rust-Oleum's specially-processed fish oil vehicle was then traced by Geiger Counter.

You stop rust, because Rust-Oleum's fish oil vehicle soaks deep down to bare metal and into the tiny pits where it drives out air and moisture that cause rust. You save, because this same *penetration* enables you to apply Rust-Oleum directly over rusted surfaces—usually eliminating costly surface preparations. Attach coupon to your letterhead for your thirty-page report entitled, "The Development of a Method To Determine The Degree of Penetration of a Rust-Oleum Fish-Oil-Based Coating Into Rust On Steel Specimens," prepared by Battelle Memorial Institute technologists.



Curved line illustrates Rust-Oleum penetration through rust as recorded by Geiger Counter.

*There is only one Rust-Oleum. It is distinctive as your own fingerprint. Accept no substitute. Buy—and specify only Rust-Oleum. You'll be happy that you did.*



Rust-Oleum is available in practically all colors, including aluminum and white.

Your nearby industrial distributor maintains complete Rust-Oleum stocks for your convenience.

# RUST-OLEUM®

## STOPS RUST!

See our Catalog in Sweets, or write for complete information.

ATTACH TO YOUR LETTERHEAD—MAIL TODAY

Rust-Oleum Corporation
2545 Oakton Street
Evanston, Illinois

- ☐ Complete literature including color charts.
- ☐ Thirty-page report on Rust-Oleum penetration.
- ☐ Nearest source of supply.

# TORRINGTON CUSTOM-MADE BEARINGS

## "This Torrington design solves my bearing problem!"

Time and again, industrial firms with special bearing requirements turn their assignments over to Torrington—specialists in designing and building custom bearings.

This confidence has been won by years of successful experience. When you call on Torrington, you engage engineers who have devoted tens of thousands of hours to the design and construction of virtually every type of bearing. From their experience—and imagination—comes the *special* bearing that will bring you peak efficiency, service life and economy.

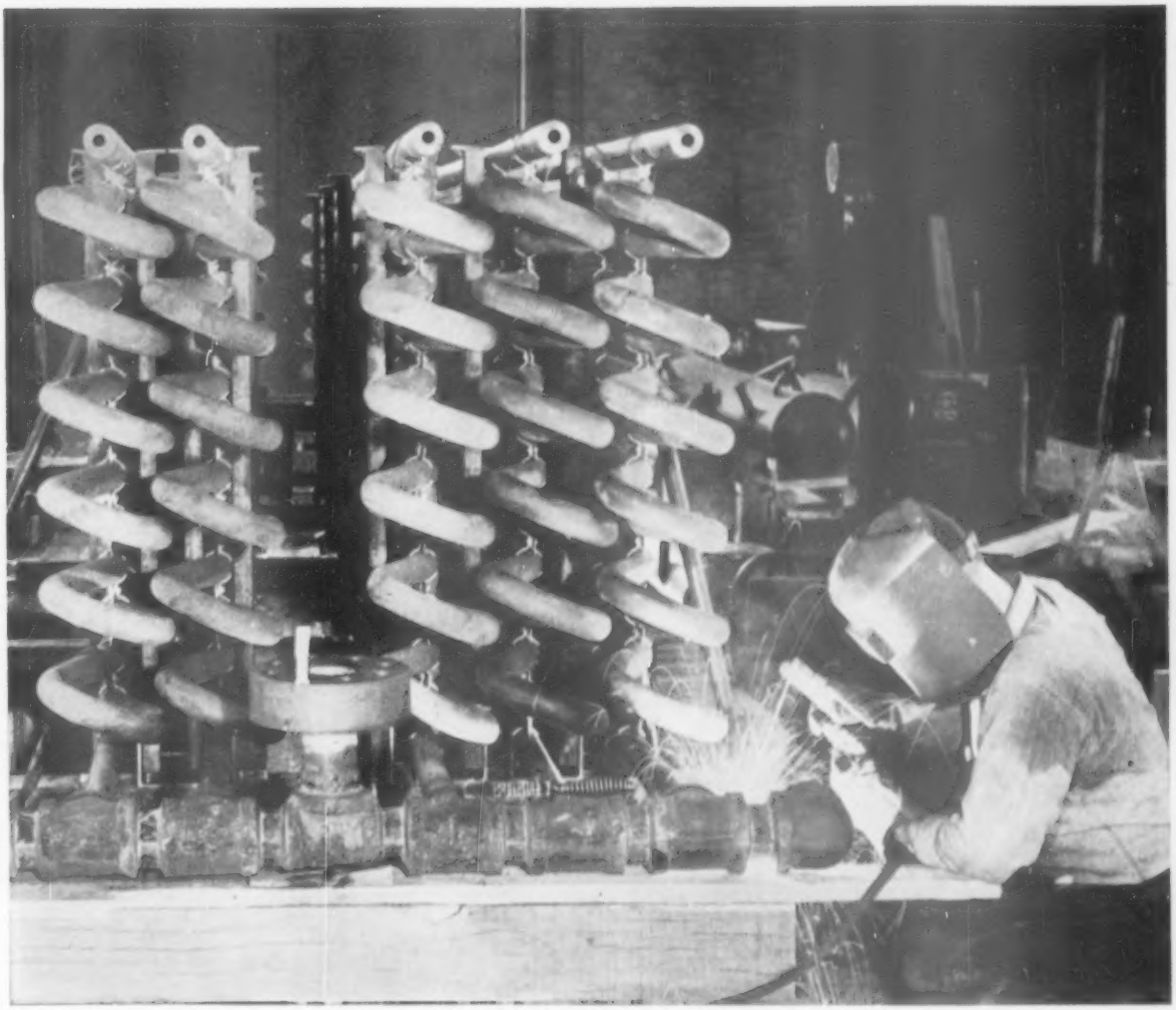
For a custom *or* standard bearing—any size, any type—you can rely on the skill and experience of Torrington.

THE TORRINGTON COMPANY
South Bend 21, Ind. • Torrington, Conn.
*District offices and distributors in principal cities of United States and Canada*

90th ANNIVERSARY 1854–1944

**TORRINGTON BEARINGS**

Spherical Roller • Tapered Roller • Cylindrical Roller
Needle • Ball • Needle Rollers



# Putting the Chill on $NH_3$

**The Vilter Manufacturing Co.** of Milwaukee, Wis., makes, among other interesting and useful products, ammonia ($NH_3$) synthesis coolers. These coolers must contain the newly-made hot gas at a pressure of 10,000 psi and reduce its temperature by means of cooling water conducted over the tubes.

To meet its exacting requirements, Vilter chose B&W Seamless Tubing, made for high-pressure service. All tubing in these coolers is tested at 15,000 psi.

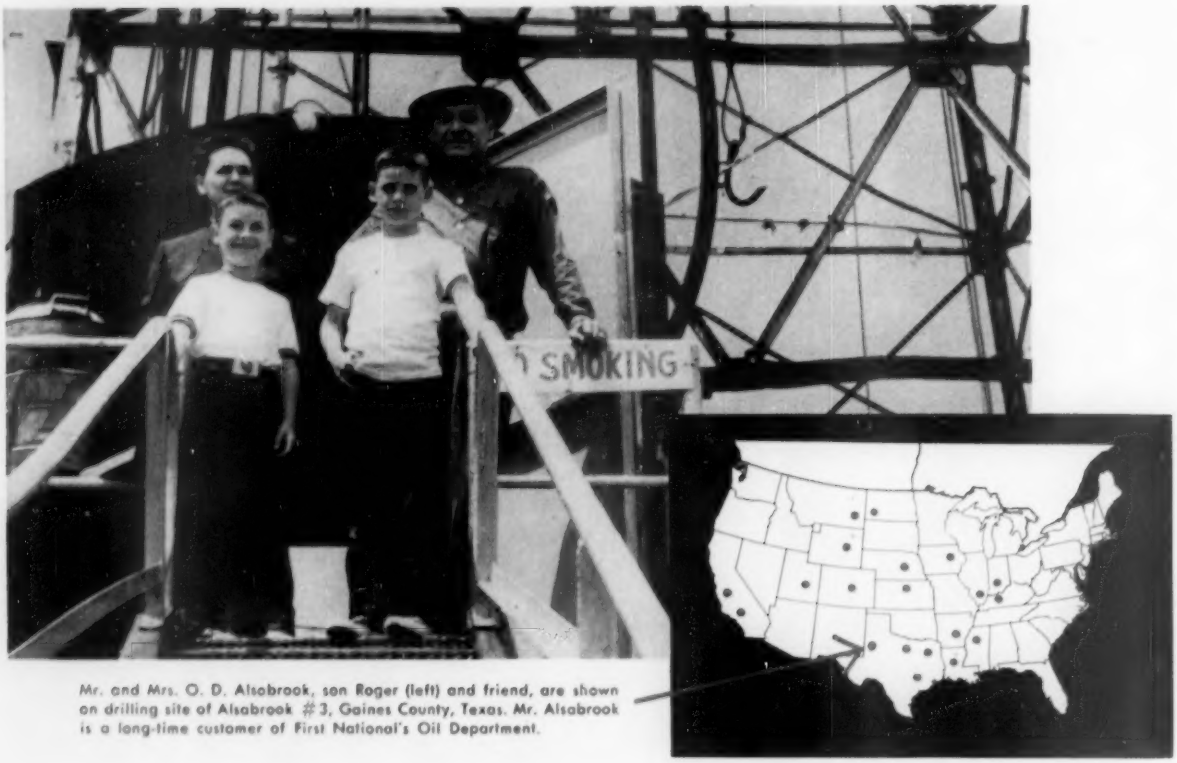
To bend these heavy-wall tubes to a 4″ radius, 3⅛″ off the vertical plane, is evidence of Vilter's skill and craftsmanship at work.

And for evidence of how B&W tubing can help improve your own skill and craftsmanship, get in touch with Mr. Tubes, or write for Bulletin 408. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

TA6032-P

Seamless and welded tubular products, seamless welding fittings and flanges—in carbon, alloy and stainless steels

*Financing from the* **FIRST** *in Dallas goes where you go!*




Mr. and Mrs. O. D. Alsobrook, son Roger (left) and friend, are shown on drilling site of Alsobrook #3, Gaines County, Texas. Mr. Alsobrook is a long-time customer of First National's Oil Department.

- Straight collateral loans on oil or gas producing properties, secondary recovery, refining plants, pipe lines and progressive loans.
- Oil and gas payment loans.

**FIRST NATIONAL BANK in Dallas**

Member Federal Deposit Insurance Corporation

*put FIRST financing in your own oil future*

# The best way to get the most for your tube steel dollar: *Ask the experts!*

*This month's report is on:* **2% CR.-MO.**

Has intermediate corrosion resistance in combination with good creep strength and fair resistance to oxidation. For use at temperatures up to 1200°F. in cracking coils, reforming units, heat exchangers, vapor line and hot oil piping, and return-bend forgings for oil heaters.

**ONE OF 24 TIMKEN HIGH TEMPERATURE STEELS**

| | | | |
|---|---|---|---|
| Carbon | Sicromo 2 | Sicromo 5S | 18-8 Ti |
| Carbon-Mo. | Sicromo 2½ | Sicromo 5MS | 16-13-3 |
| DM-2 | 2½% Cr.-1% Mo. | Sicromo 7 | 25-20 |
| Silmo | Sicromo 3 | Sicromo 9M | 25-12* |
| DM | 4-6% Cr.-Mo. | 18-8 Stainless | 35-15** |
| 2% Cr.-Mo. | 4-6% Cr.-Mo.-Ti | 18-8 Cb | 16-25-6** |

** Available as seamless tubing on an experimental basis only.*
***Not available as seamless tubing.*

THERE are probably several high temperature tube steels that will solve your heat, pressure, corrosion or oxidation problems. But there's only one that will give you the most for your tube steel dollar—the best life/cost ratio.

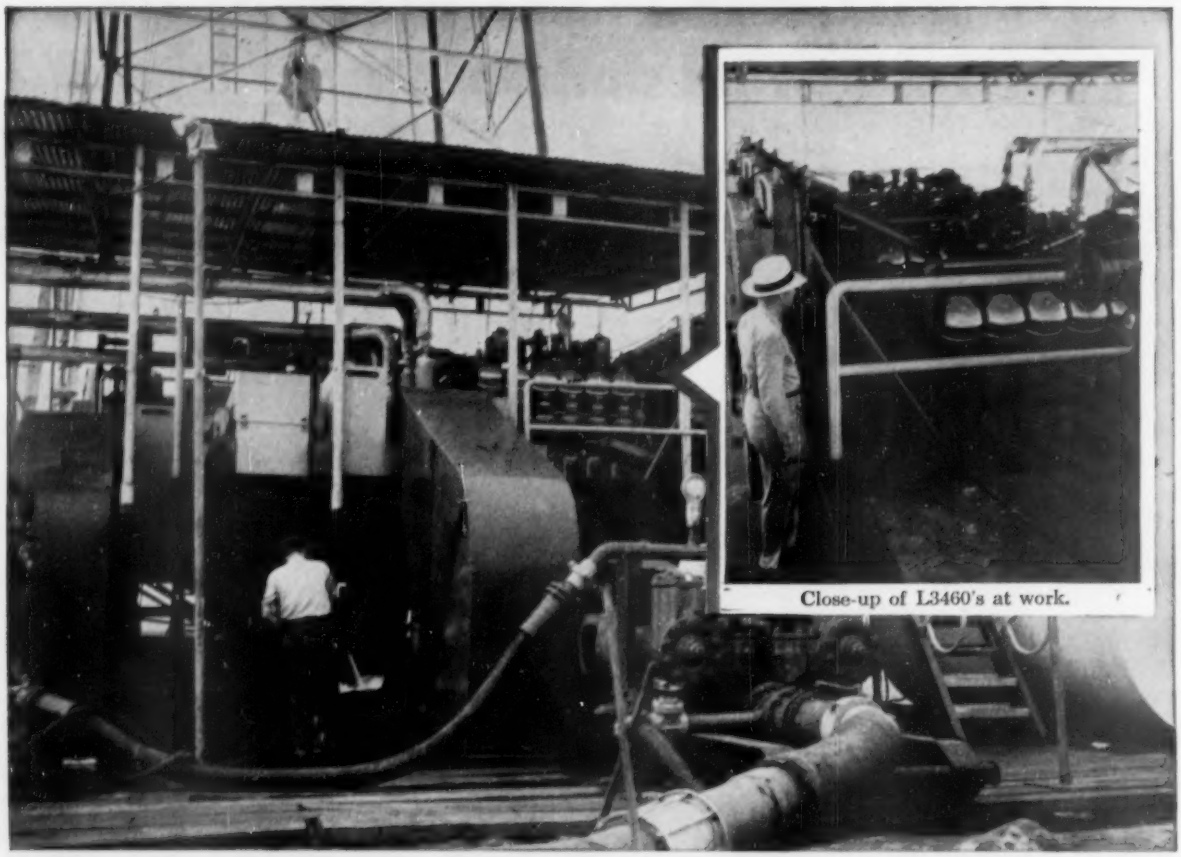
The best way to find it is to ask Timken Company metallurgists. They're recognized authorities on high temperature steels. With 23 years of experience behind them, they can help you select your best steel from 24 different analyses. You'll be sure of getting the most for your tube steel dollar. And you'll be assured of uniform quality in every tube because The Timken Company rigidly controls quality from melt shop through final inspection.

For help with your tube steel problems, *ask the experts!* The Timken Roller Bearing Company, Steel & Tube Division, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

*This photo shows final tube inspection—last of hundreds of rigid tests that help account for the uniform quality of Timken high temperature steels.*

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING



Close-up of L3460's at work.

# *Here's the Way to Power a Rig... for Deep Holes!*

**... use LeRoi L3460 or L4000 V-12 drilling engines to get the outstanding acceleration and lugging power you need for faster round trips**

If you have an engine that can stand the gaff on deep holes — you have an engine that can help you bottom any hole at lower cost.

The L3460 and L4000 can do just that. It's been proven time and time again.

Let's look at the L3460. It develops 600 hp maximum. On one rig two of these engines hoisted 5-inch pipe from 8300 feet in just two hours — and this was a wet trip. That's proof of both acceleration and lugging power.

The L4000 is the L3460's twin except for displacement. It produces 655 maximum hp. Both engines are only 164 inches long so that they have the compactness that helps you keep to overall width and weight limitations. And they're built to stand oil-field handling.

Not only do you get more horsepower per dollar from these V-12's, but you also get these important features: Short-stroke design that gives you greater horsepower and speed, without compromising engine life. Wide speed range up to 1350 rpm. Operation on oilfield fuels —natural gas or butane. Conservative rating. Lightweight pistons, hydraulic tappets, short-radius rotating parts, and sensitive controls to provide hair-trigger response to load demands.

Yes, you can drill them deep and drill them fast with L3460's or L4000's. Let your supply house or Le Roi distributor show you why. If you want descriptive literature, just write us for it

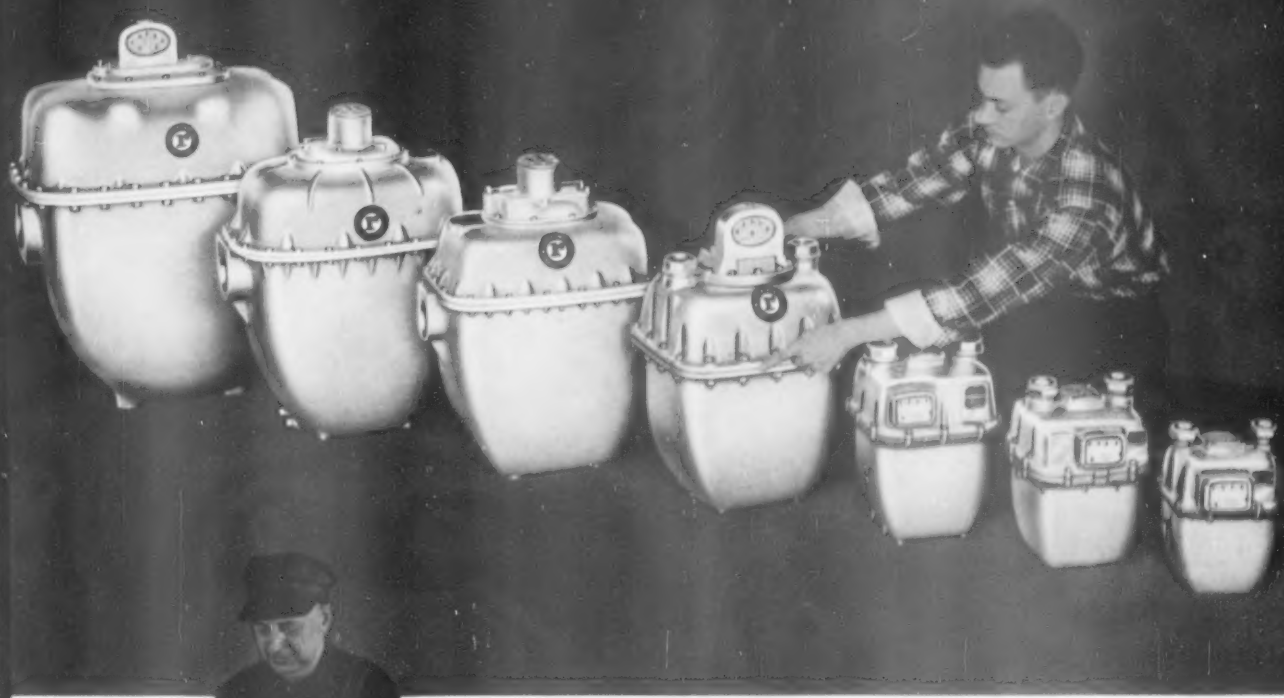
P-236

**LE ROI** *Division of Westinghouse Air Brake Co.*

Milwaukee 1, Wisconsin

PORTABLE AIR COMPRESSORS TRACTAIR STATIONARY AIR COMPRESSORS AIR TOOLS ENGINES

# They're All ROCKWELL *Single Joint* Gas Meters...



## Cost Less to Maintain

Just break the main joint at the cover casting and lift the entire measuring assembly from the bowl type body. Replace the old unit with either a new or rebuilt duplicate and the meter is ready for another period of extended service. A screw driver is the only tool needed to make this switch. Write for full details.

## *Only one main gasketed joint to seal — easiest to service*

Single joint construction is an exclusive feature in Rockwell aluminum meters. Size for size there are fewer linear inches of pressure sealing surfaces than in other type meters. There's less chance for leakage in this design and greater ease and accessibility for maintenance. The completely enclosed valve plate casting carries all the working parts. It fits, pre-assembled, in the bowl type body to bring you the advantage of unit replacement economy. You can select from a *complete line* of Rockwell single joint meters covering capacity range from 150 cfh to 5000 cfh. *Write for bulletin.*

ROCKWELL

## ROCKWELL MANUFACTURING COMPANY

PITTSBURGH 8, PENNSYLVANIA

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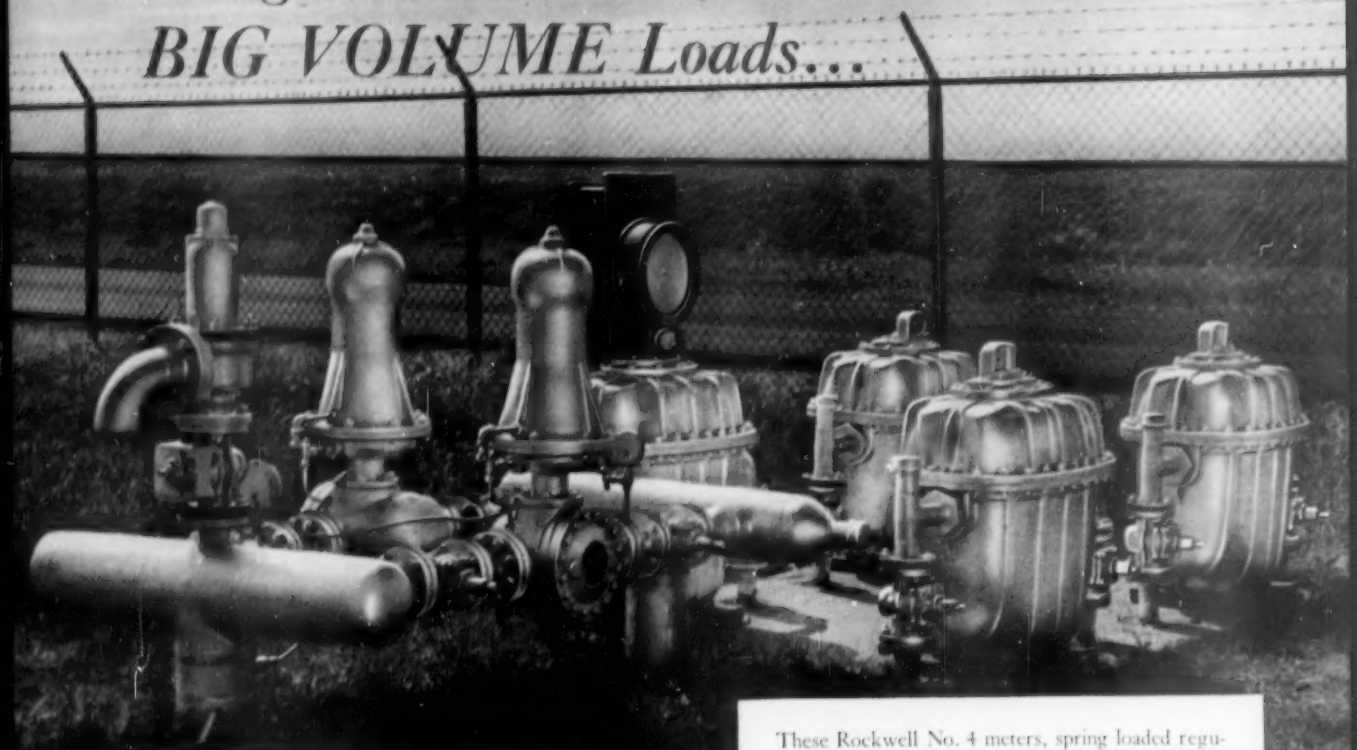
| Atlanta | Boston | Charlotte | Chicago | Dallas | Denver |
| Houston | Los Angeles | Midland, Texas | | Kansas City, Mo. | New York |
| Philadelphia | Pittsburgh | San Francisco | Seattle | Shreveport | Tulsa |

# *Taking the measure of BIG VOLUME Loads...*



These Rockwell No. 4 meters, spring loaded regulators and Rockwell-Nordstrom valves measure and control gas furnished Chanute Air Force Base.

## Rockwell Meter Gauges

### The Emcorector

An integrating gauge that gives a direct reading of any volume metered at high variable pressures corrected to contract base pressure.

### Combined Record Gauge

Furnishes charted records of pressures from which metered volume to any contract base pressure can be calculated. Made in both meter and clock driven types.

## Rockwell Meters, Regulators and Nordstrom Valves

*Serving well with safety* might be the title for this picture. The spring loaded Rockwell "015" regulators are completely enclosed to prevent tampering. The sturdy cased Rockwell No. 4 meters withstand external forces and internal stress far above any normal expectancy. Leak resistant Rockwell-Nordstrom valves with their lubricant sealed plugs and quick, quarter-turn operation assure positive, ever ready control. For your next installation, why don't you go Rockwell all the way? Gain the security that comes from using only the finest, safest equipment.

**ROCKWELL MANUFACTURING COMPANY**

**PITTSBURGH 8, PA.** Atlanta Boston Charlotte Chicago Dallas Denver Houston Kansas City, Mo. Los Angeles Midland, Texas New York Philadelphia Pittsburgh San Francisco Seattle Shreveport Tulsa

## *Meters and Regulators For Your Every Purpose and Need*

### METERS

Tin

Aluminum

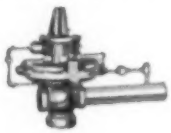
Cast Iron

Pressed Steel

### REGULATORS

Industrial

Service



"1001"

Balanced Valve

Thirty-foot lengths of 2-inch, Schedule 40 National PVC Plastic Pipe. Each of these easy-to-handle lengths actually weighs less than 20 pounds.

# 2,800 feet of
# USS NATIONAL* PVC PLASTIC PIPE
# laid in 1¾ hours

The TXL Oil Corporation is putting National Polyvinyl Chloride Plastic Pipe to its first rough oil field test—as a gathering line subject to paraffin deposits. A pipe laying crew made the installation in the Permian Basin, 12 miles south of Odessa, Texas, laying the 2,800-foot line in less than an hour and 45 minutes.

Normal impact, two-inch, plain-end pipe was used. Fittings were attached by solvent cementing. The 90 lengths of pipe were coupled at the rate of almost a joint a minute.

* * *

National Polyvinyl Chloride Plastic Pipe is available in two types, in sizes ½" to 6" inclusive and in Schedules 40 and 80.

**NORMAL-IMPACT**—for installations requiring the highest chemical resistance attainable, together with high strength and excellent creep resistance.

**HIGH-IMPACT**—for installations requiring excellent chemical resistance and a high degree of toughness even at low temperatures.

Polyvinyl Chloride Pipe possesses high chemical resistance to acids, alkalis, salt solutions, alcohols and many other chemicals. It is rigid and light weight . . . can be joined by threading (Schedule 80 only), by solvent cementing, heat welding or with adhesives. National Polyvinyl Chloride Plastic Pipe is marked every 2 feet with size, schedule, pressure and temperature.

Nontoxic, the pipe resists deterioration from sunlight, fungi, bacterial action and soils. Its smooth internal surface offers low flow resistance.

For further information on USS National Polyvinyl Chloride Plastic Pipe, send for Bulletin No. 24. Write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

*Trademark

Fitting being solvent-cemented in place.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS · UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS NATIONAL *plastic* PIPE

UNITED STATES STEEL

# *Bucyrus-Erie Dragshovels*

# SPEED UP TOUGH PIPELINE TRENCHING

Rough and rocky trenching like this calls for the kind of dependable performance you get from a Bucyrus-Erie dragshovel. This 22-B is working in northern Pennsylvania on a 24-in. natural gas line.

High-output is a traditional characteristic of Bucyrus-Erie dragshovels because of the high hoist speed and extra power on the digging stroke. The cambered boom lets you dig in close to crawlers. The dipper has sloping sides, side cutters with straight edges, and extended lip area for fast digging and heaped loads.

Tractor-type treads have deep grousers for sure traction in soft ground and for climbing steep grades. Added clearance lets you travel over rocks, stumps and other obstacles—16½ in. on the 15-B, and 20¾ in. on the 22-B. Special sealing protects track-roller bearings against damage from water, dust, dirt and grime.

More and more spreads are demonstrating that it pays to depend on Bucyrus-Erie dragshovels. Your distributor will give you complete details on the ½-yd. 15-B and ¾-yd. 22-B.

235E56

BUCYRUS ERIE

South Milwaukee Wisconsin

One man in this midget fire truck puts out the fire. Rockwood equipment makes it possible!

# "Mighty Mite" puts out fire in 45 seconds

"Mighty Mite" is a swift fire fighter!

It was just a test, but the fire was real. Fuel in a pit under the tank car was set on fire. Fuel poured on top of the car from pipes was also ignited. The blaze was given a minute's start.

"Mighty Mite", loaded with Rockwood fire fighting equipment, went into action. The blaze was choked off in 45 seconds by Rockwood WaterFOG from Rockwood's Remote Manual Control Turret!

Rockwood equipment makes the small truck a big fire fighter. The Turret Nozzle does many jobs—discharges solid water stream, WaterFOG, FogFOAM, solid FOAM stream, "Wet" solid water stream, and "Wet" WaterFOG!

For complete details on this powerful Rockwood equipment send coupon below.

## ROCKWOOD SPRINKLER COMPANY

*Engineers Water . . . to Cut Fire Losses*

***Distributors in all principal cities***

"Mighty Mite's" equipment includes: 4 stage centrifugal pump, 200-gallon booster tank, Rockwood Dual Suction Proportioning System for FOAM and "Wet", Rockwood Remote Manual Control Turret controlled from within the cab, Rockwood Ground Sweep Nozzles, Rockwood Remote Control Ball Valves, 2 hose reels with 200 feet of high pressure hose with new Rockwood High Pressure Handline Nozzle on each reel.

ROCKWOOD SPRINKLER COMPANY
Portable Fire Protection Division
1072 Harlow Street
Worcester 5, Mass.

Please send me your illustrated booklet on Rockwood fire fighting products.

*Name* .....

*Title* .....

*Company* .....

*Street* ..... *City* .....

*Zone* ..... *State* .....

*Tennessee Gas Transmission Company's*

# "Muskrat Line" submarines

# toward completion...

**The "Muskrat Line",** with its feeders, covers a total of 355 miles. From point A, off the Louisiana Coast, it runs generally westward across the Mississippi River Delta and along the Louisiana coast. And at point B (Crowley, La.) it hooks up with the existing gathering system. Only the last 70 miles of the line, before it reaches Crowley, involved normal dry land construction techniques.

## New 355-mile pipe line extension gets colorful name from wild swamps and marshlands it traverses. *Four-fifths of it will be laid under water.*

THE "Muskrat Line" extension is part of this company's current $56,000,000 pipe line and compressor expansion program. When completed, the program will give the Tennessee Gas system a total of more than 9500 miles of pipe line in 15 states. Average daily delivery capacity will then be 1,800,000,000 cubic feet.

A. O. Smith Corporation is proud to be a part of this new extension by furnishing the 18 and 20 inch and a portion of the 24-inch line pipe.

The purpose of this new construction is to bring important new onshore and offshore natural gas reserves to the customers of Tennessee Gas.

The magnitude of the work involved in building the "Muskrat Line" is indicated by the facts that special canals had to be dredged through the marshlands . . . special pipe-laying barges had to be built . . . and 130 navigable bodies of water had to be crossed. Completion of the "Muskrat Line" is expected by mid-summer.

---

*Through research* A.O. Smith *. . . a better way*

**A.O.Smith**
CORPORATION

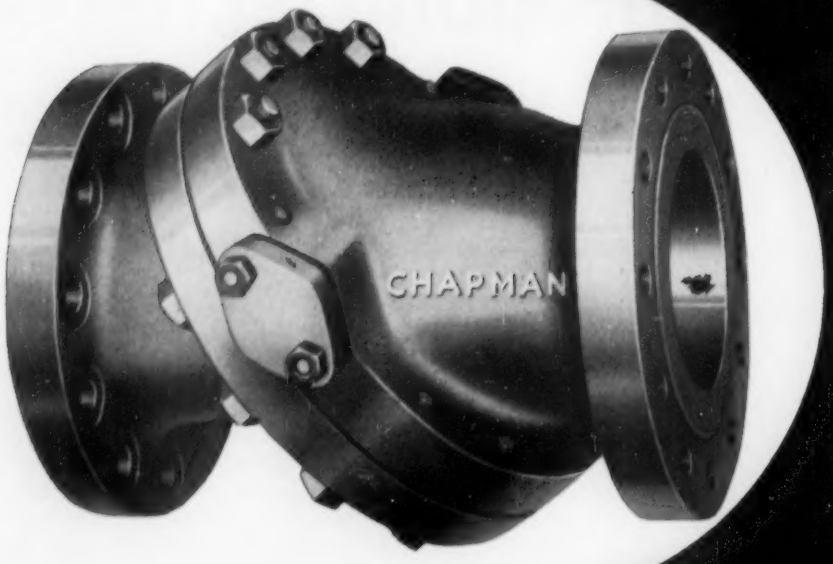
**TUBULAR PRODUCTS DIVISION**
**Milwaukee 1, Wisconsin**

Chicago 4 • Dallas 2 • Los Angeles 22 • Midland 5, Texas • New Orleans 12 • New York 17 • Pittsburgh 19 • San Francisco 4 Seattle 1 • Tulsa 3 • Washington 6, D. C.
International Division: Milwaukee 1, Wisconsin

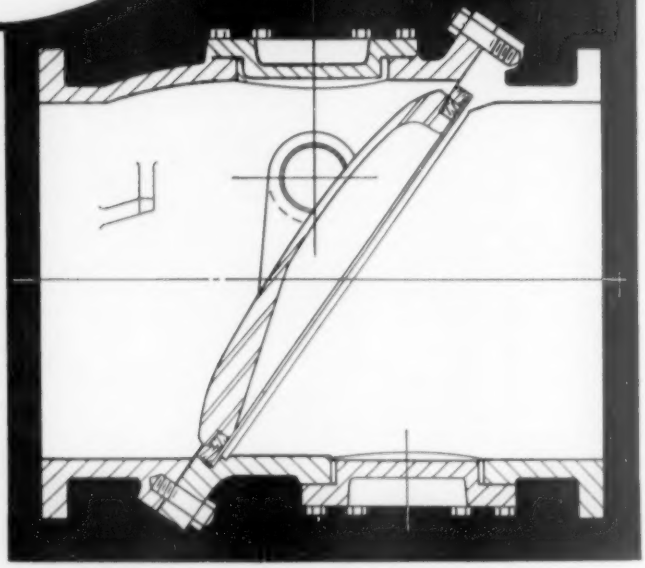
### *FOR ALMOST 30 YEARS . . .*

A. O. Smith has held a high standard of quality control and this quality control has been maintained at every step of the manufacturing process. That's why A. O. Smith pipe made and installed in 1928 is still in operation. That's why so much A. O. Smith pipe has been used in nearly every important high-pressure line.

# CHAPMAN TILTING DISC CHECK VALVE




*the Valve with the Right Idea!*



Here is a cross section of top check valve performance at lowest cost. It's the idea in back of Chapman's Tilting Disc Check Valve . . . the valve that's designed to go with the flow.

When the flow is on, specially designed "airfoil" disc balances perfectly in open position. Fluid holds it tightly against stops. There's no vibration . . . no flutter. It's quiet. And note the design. Ample room is allowed around disc to assure low flow resistance.

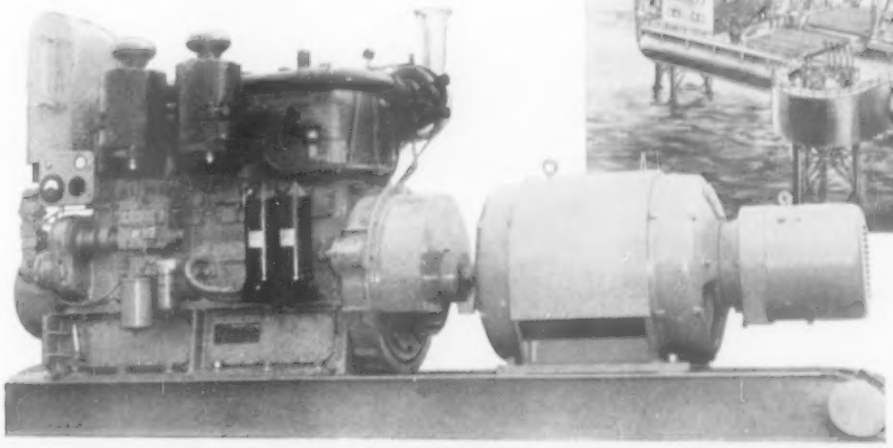
When the flow is reversed, disc drops surely, quietly; *tightly* on special beveled seat. There's no banging, no slamming, no scraping or wearing of disc and seat faces, no damage to piping joints or the valve itself. It's as simple as that. It's as *sound* as that. It has the right idea.

Complete information on these rugged, quiet, long life check valves is highlighted in our Catalog 30-A. Whether you want iron or steel construction . . . whether you handle fluids or gases under a wide range of pressures . . . this catalog gives you all the facts. Send for your up-to-date copy, today.

**The CHAPMAN VALVE Mfg. CO.**

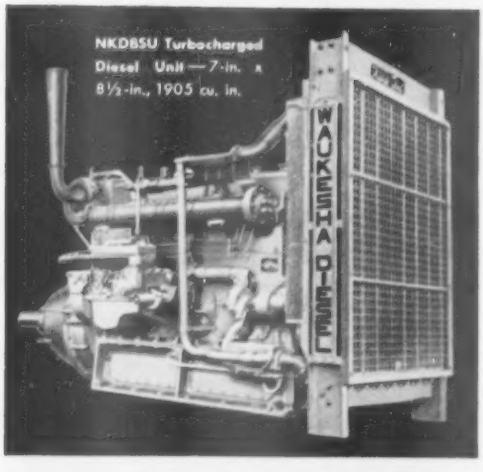
**INDIAN ORCHARD, MASS.**

# *on the* ZAPATA off-shore platform



# WAUKESHA

## *Turbodiesels* supply reliable generator power




This mobile off-shore platform of the Zapata Off-Shore Company of Houston, Texas, has two engine generator sets to supply auxiliary power. A 1200 rpm Model NKDBS Waukesha Turbodiesel powers each of these 200 KW, 3-phase, 120/208 volt generator sets which are built by the Reagan Equipment Co. of New Orleans, La.

The Waukesha NKDBS is a 6-cyl., 1905 cu. in., counterbalanced crankshaft, turbo-supercharged Diesel. A rugged, compact engine, it has lively acceleration, clean burning, prompt starting, and great overall economy. Waukesha's exhaust turbocharger system, unique patented combustion chamber, and design features proved in many years' service provide smooth, **extra** power—up to 368 hp in this NK Series Turbodiesel. Send for Bulletin 1634.

50th ANNIVERSARY Waukesha 1906-1956

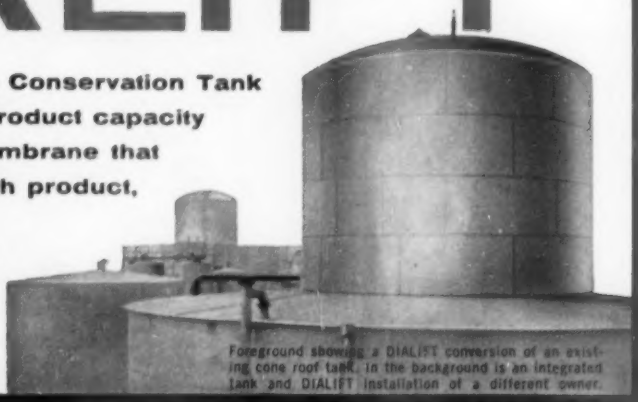
314

**WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN**

New York • Tulsa • Los Angeles

# The HAMMOND DIALIFT

**The ONLY membrane type Conservation Tank with full-rated vapor and product capacity AT ALL TIMES, with a membrane that cannot come in contact with product, vapor space that can be isolated for inspection and maintenance without taking product storage tank out of service.**



Foreground showing a DIALIFT conversion of an existing cone roof tank. In the background is an integrated tank and DIALIFT installation of a different owner.

**Principle of the Hammond Dialift**

A—DIALIFT DIAPHRAGM rises and falls to accommodate expanding and contracting vapor.
B—Vapor passes to and from tank and DIALIFT through simple elbow connection.
C—DIALIFT and tank have full-rated capacity.
D—Membrane can't come in contact with product.
E—DIALIFT can be isolated for maintenance and inspection, product tank stays in service.

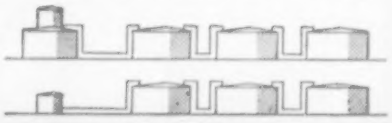
**The most efficient and economical vapor conservation system for new or old tanks.**

THE HAMMOND DIALIFT consists of a gas-tight Vulcalock membrane attached to the inside periphery of a cylindrical metal housing to become a "breathing" apparatus to accommodate the expanding and contracting vapor as developed in product storage tanks. The DIALIFT can be used as a single conservation unit by being attached to the roof of a product storage tank or as a central "breathing" system by being manifolded to a number of product storage tanks. There are two forms of installation: —Ground type manifolded to a number of tanks to form a conservation system and integrated type whereby the DIALIFT is attached to the roof of a product tank for vapor conservation for one or a number of tanks.

The DIALIFT is completely isolated from the product storage tank. Vapor passes between the tank and DIALIFT through a vaporline connection. It is easy to convert old cone roof tanks to efficient vapor-saving DIALIFT installations by attaching a DIALIFT housing with membrane to the roof of the old tank and connecting the vaporline between the tank and DIALIFT.

New or converted DIALIFT tank, inter-connected with cone-roof tanks, becomes central "breathing" unit.

DIALIFT GROUND UNIT serves as central "breathing" apparatus of multi-tank conservation system.



**THE HAMMOND DIALIFT ELIMINATES BREATHING LOSS AND REDUCES FILLING LOSS**

**Write for catalog 55DL**

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# Products for the Oil Industry by Avondale

products by AVONDALE . . . offshore drilling platforms, drilling barges, towboats, tugboats, barges—any and all kinds of marine equipment for the Oil Industry! AVONDALE products are in step with the fast-moving Oil Industry. AVONDALE products are known and famous in the Oil Industry. If you are considering construction or repairs—call on AVONDALE!

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# PRODUCTION-PROVED FOR RUGGED SERVICE

## ATLAS ROLLER CHAIN HAS EXTRA LIFE BUILT IN EVERY LINK...FOR LOWER COSTS PER DRIVE

Tested to be tough . . . machined for the smoothest operation. Each length of Atlas Chain has been Pre-tested for extra hardness to resist wear . . . tested for tensile strength to exceed the demands of any drive . . . checked for smooth following, quiet transmission.

The link plates and rollers are made of tough, heat-tested alloy steel; their uniformity maintained with automatic electronic safeguards. Atlas Chain operates with a velvety smoothness made possible by precision made bearings rolling at every point of contact. These bearings—pins, bushings, and rollers—are of specially selected steels finished by Atlas' exclusive "Mirro-Finish process."

Team up this "super-life" chain with Atlas Precision Matched Sprockets and you have an unbeatable, peak-efficiency drive that minimizes wear...provides greater efficiency and economy, on every drive. Write today for the complete Atlas catalog and data book on chains and sprockets, to Atlas Chain & Manufacturing Company, West Pittston, Pa.

# ATLAS

## ROLLER CHAIN AND SPROCKETS

# Save up to $219 per mile

## with new Kaiser Aluminum pipe and couplers!

**As you can see** in the chart below, *big* savings are possible when you use lightweight Kaiser Aluminum pipe and couplers instead of heavy steel pipe for your drill rig supply lines.

**Laying one mile of 4-inch oil rig supply pipe***

**Aluminum vs. Steel**

| | STEEL | | ALUMINUM | |
|---|---|---|---|---|
| OPERATION | MAN HOURS | COST | MAN HOURS | COST |
| Loading | 10.66 @ $2.20 | $ 23.46 | 3.25 @ $2.20 | $ 7.15 |
| Stringing (Trucker) | 1.66 @ $1.82 | 3.03 | .83 @ $1.82 | 1.52 |
| (Crew) | 3.33 @ $2.20 | 7.33 | 1.66 @ $2.20 | 3.65 |
| Connecting | 43.33 @ $2.20 | $ 95.33 | 3.00 @ $2.20 | $ 6.60 |
| Disconnecting | 26.25 @ $2.20 | $ 57.75 | 5.00 @ $2.20 | $11.00 |
| Pick-up and reloading | | | | |
| (Trucker) | 7.25 @ $1.82 | 13.20 | 1.33 @ $1.82 | 2.42 |
| (Crew) | 29.00 @ $2.20 | 63.80 | 5.33 @ $2.20 | 11.73 |
| Total | 121.48 | $263.90 | 20.40 | $44.07 |

**Total savings with Kaiser Aluminum pipe—$219.83!**

*Figures compiled from extensive installations by Kaiser Aluminum in Texas. Total savings could be more or slightly less, according to local conditions.

The main reasons for these huge savings are extremely light weight and easy coupling. A 30-foot length of 4-inch Kaiser Aluminum pipe weighs only 31 pounds, while an equivalent length of steel pipe weighs 323 pounds—293 pounds more!

The new quick-connecting aluminum couplers require no welding. One man easily joins pipe sections right in the field with no special equipment. Result: 61½ man-hours saved in disconnecting and connecting time!

Your nearby supplier stocks Kaiser Aluminum petroleum pipe in 30-foot lengths of 2, 3 and 4 inch diameters.

**Skidding time reduced** from 52 man-hours to only 12½ man-hours by using aluminum pipe instead of heavy steel pipe. One and a half miles of 4" aluminum pipe is an easy load in a truck built to carry steel pipe.

He also has the necessary couplers and fittings to complete your system.

Kaiser Aluminum petroleum pipe is roll-formed and induction welded from high-strength aluminum alloy sheet. Each length is hydrostatically tested at a pressure of 1000 psi. Inside surface is clad with high-purity aluminum to increase resistance to corrosion.

For further information on the pipe and couplers, contact the Kaiser Aluminum sales office listed in your telephone directory.* Kaiser Aluminum & Chemical Sales, Inc., *General Sales Office*, Palmolive Bldg., Chicago 11, Illinois; *Executive Office*, Kaiser Bldg., Oakland 12, California.

# Kaiser Aluminum

**setting the pace—in growth, quality and service**

***Information may also be obtained from the following suppliers:***

**REPUBLIC SUPPLY COMPANY**
**Republic Building (Home Office)**
**Oklahoma City, Oklahoma**

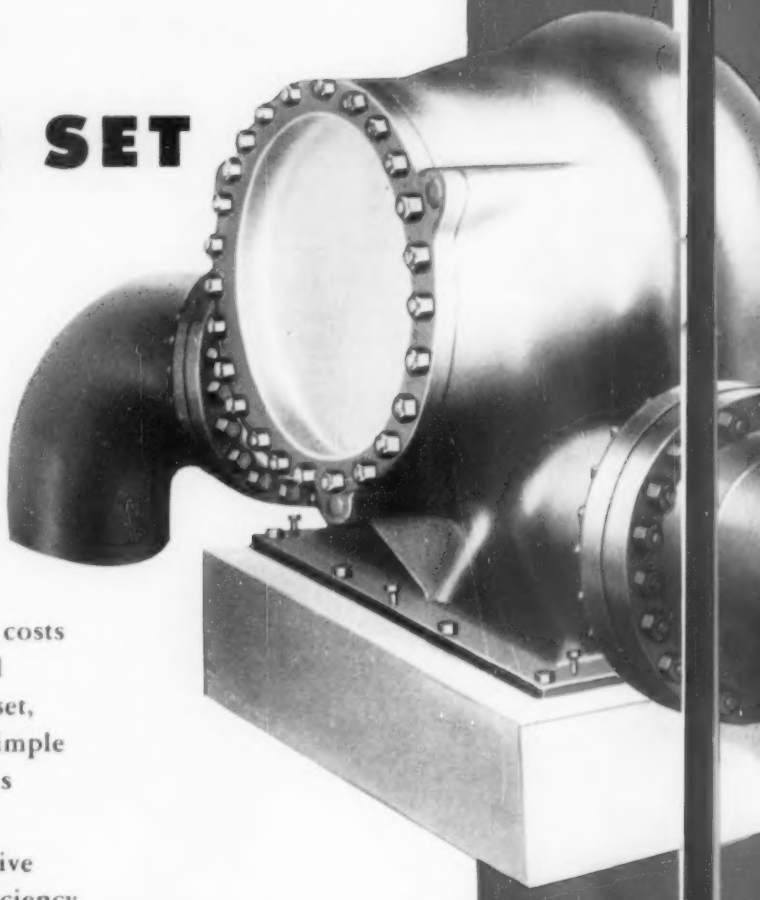
**DUNIGAN TOOL & SUPPLY COMPANY**
**1534 South Treadaway (Home Office)**
**Abilene, Texas**

# NORDBERG
## *Supairthermal*®
## ENGINE GEAR SET

**for reducing gas pipe line transmission costs . . .**

☆ *THERMAL EFFICIENCY IN EXCESS OF 40%*

☆ *LOWEST INSTALLED COST*



Savings of thousands of dollars per day in fuel costs on large capacity gas pipe lines can be realized with the Nordberg *Supairthermal* engine gear set, driving a centrifugal gas compressor, for the simple reason that less fuel is required to transport gas than by any other modern type of equipment.

This performance is possible through exclusive design principles which produce a thermal efficiency of better than 40 per cent—with increased horsepower, lower lube oil consumption . . . and lower maintenance costs per horsepower-hour.

Extremely compact and efficient, this unit can be installed with lower capital investment and operated at lower cost per horsepower-hour than any other type of gas pipe line prime mover.

*Call or write for full details, outlining your requirements.*

Nordberg *Supairthermal* V-type spark-ignition gas engine driving a centrifugal gas compressor. V-type engines for this service are built with 10, 12, 14 and 16-cylinders, offering a range up to 5,000 horsepower per engine.

**NORDBERG**

DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

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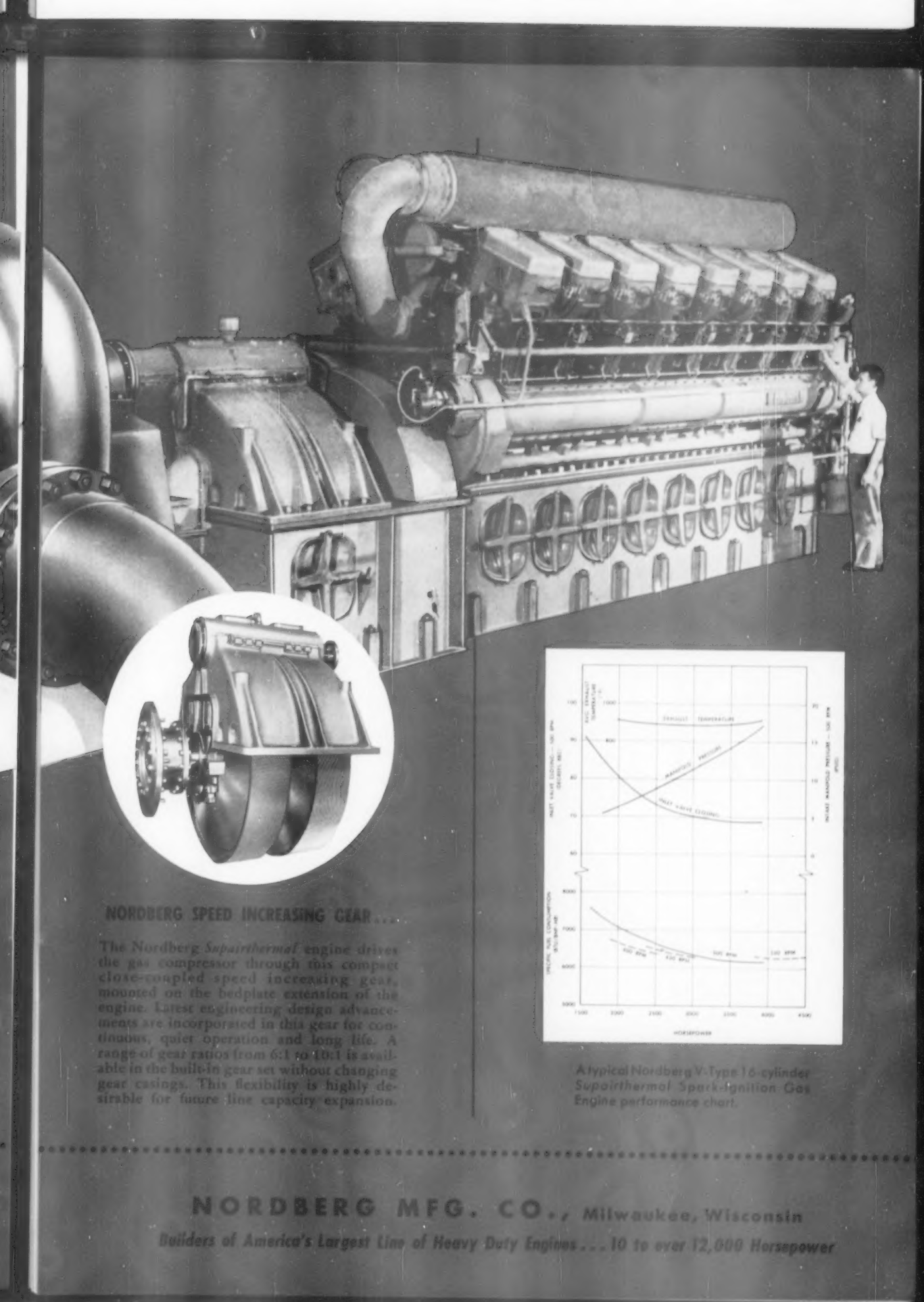


## NORDBERG SPEED INCREASING GEAR....

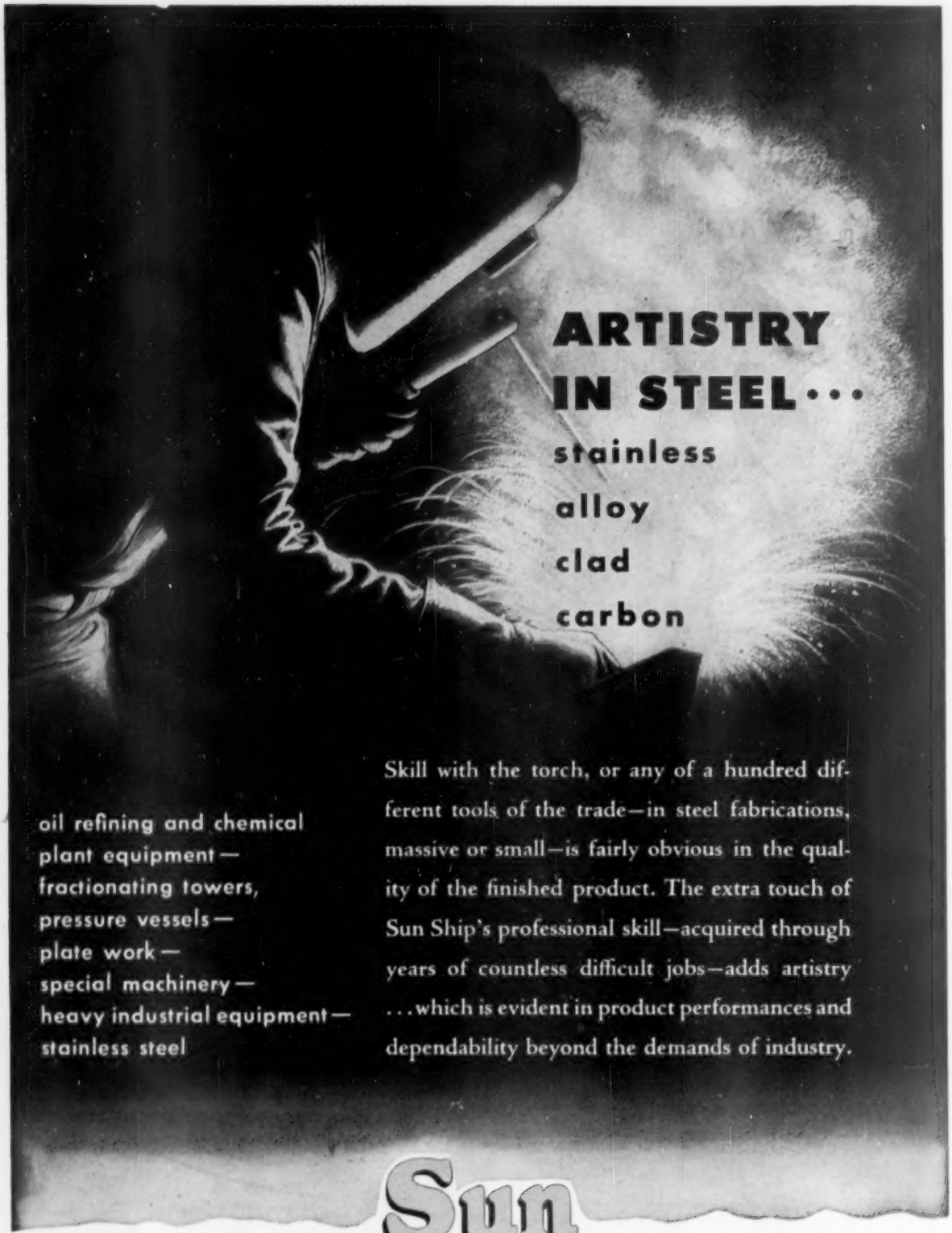
The *Nordberg Supairthermal* engine drives the gas compressor through this compact close-coupled speed increasing gear, mounted on the bedplate extension of the engine. Latest engineering design advancements are incorporated in this gear for continuous, quiet operation and long life. A range of gear ratios from 6:1 to 10:1 is available in the built-in gear set without changing gear casings. This flexibility is highly desirable for future line capacity expansion.



A typical Nordberg V-Type 16-cylinder *Supairthermal* Spark-Ignition Gas Engine performance chart.

**NORDBERG MFG. CO., Milwaukee, Wisconsin**

*Builders of America's Largest Line of Heavy Duty Engines . . . 10 to over 12,000 Horsepower*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Skill with the torch, or any of a hundred different tools of the trade—in steel fabrications, massive or small—is fairly obvious in the quality of the finished product. The extra touch of Sun Ship's professional skill—acquired through years of countless difficult jobs—adds artistry ...which is evident in product performances and dependability beyond the demands of industry.
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# PETROLEUM INDUSTRY

In the oil fields . . . refineries . . . or on transportation equipment Penflex Flexible Tubing has proved itself throughout the petroleum industry. Rugged . . . tough . . . flexible Penflex Tubing is made to stand the most severe usage.

From 1/8" to 24" I.D. . . . bronze, galvanized or stainless steel Penflex makes all types and sizes of flexible metal tubing. Penflex "Flexineering"—the science of applying flexible tubing to fit the particular needs of the petroleum industry—assures the right tubing on each installation.

When you require metal tubing that is tight as a pipe, but flexible . . . safe at high temperatures . . . and free from metal fatigue specify Penflex. Write for your copy of "Flexineering" today.

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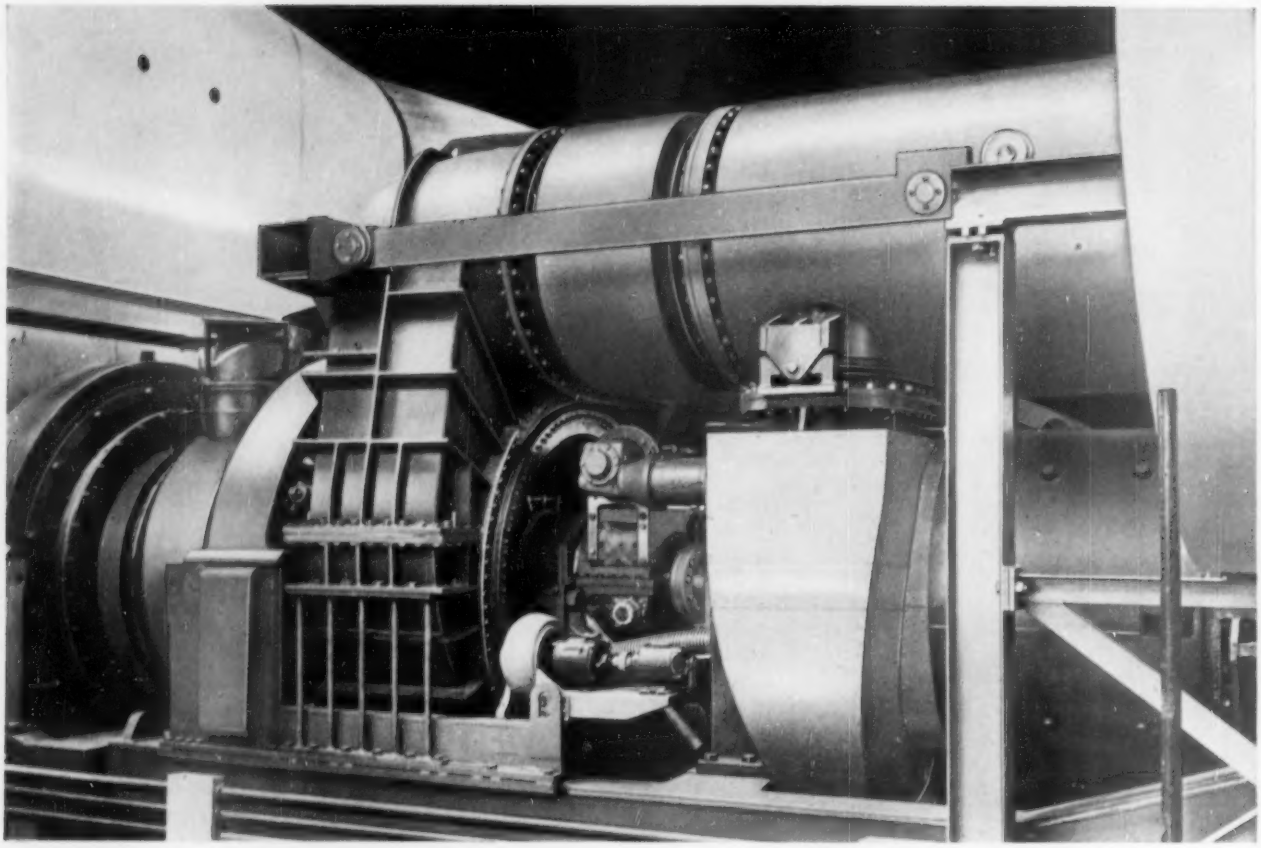
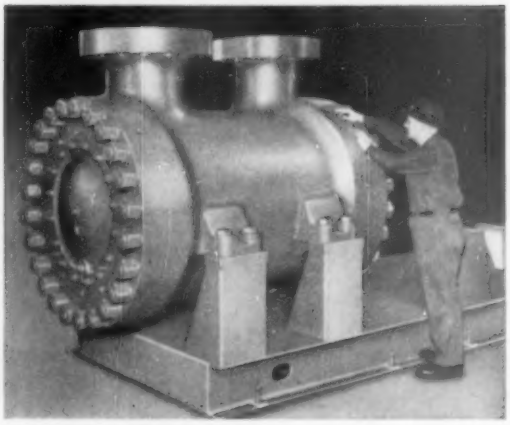
LIFELINES

# GAS TURBINES



Clark 8500 BHP Gas Turbine for centrifugal compressor, generator or pump drive

Clark Barrel Type Centrifugal Compressors for extremely high pressures



CLARK®

GAS TURBINES
CENTRIFUGAL COMPRESSORS

# CENTRIFUGAL COMPRESSORS
# Only CLARK builds both!

Now you can get centrifugal compressors and modern gas turbines to drive them *exclusively* from one manufacturer . . . Clark.

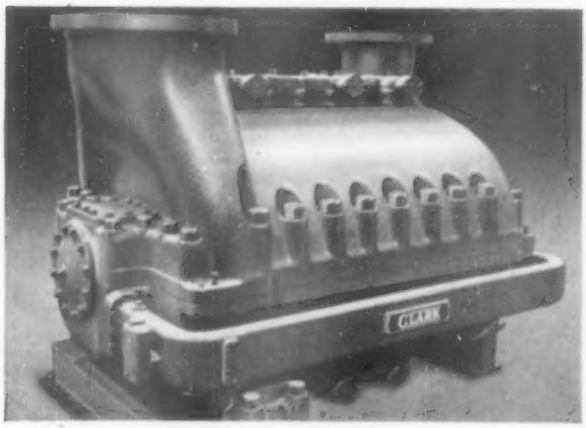
In addition to saving money and headaches, you'll get proved, matched-performance "packages" specifically designed for continuous trouble-free service.

Whether you have a million or a billion cubic feet of air or gas per day to handle at pressures of up to 4500 pounds per square inch, there is a Clark centrifugal compressor and in most cases a matching Clark gas turbine to drive it.

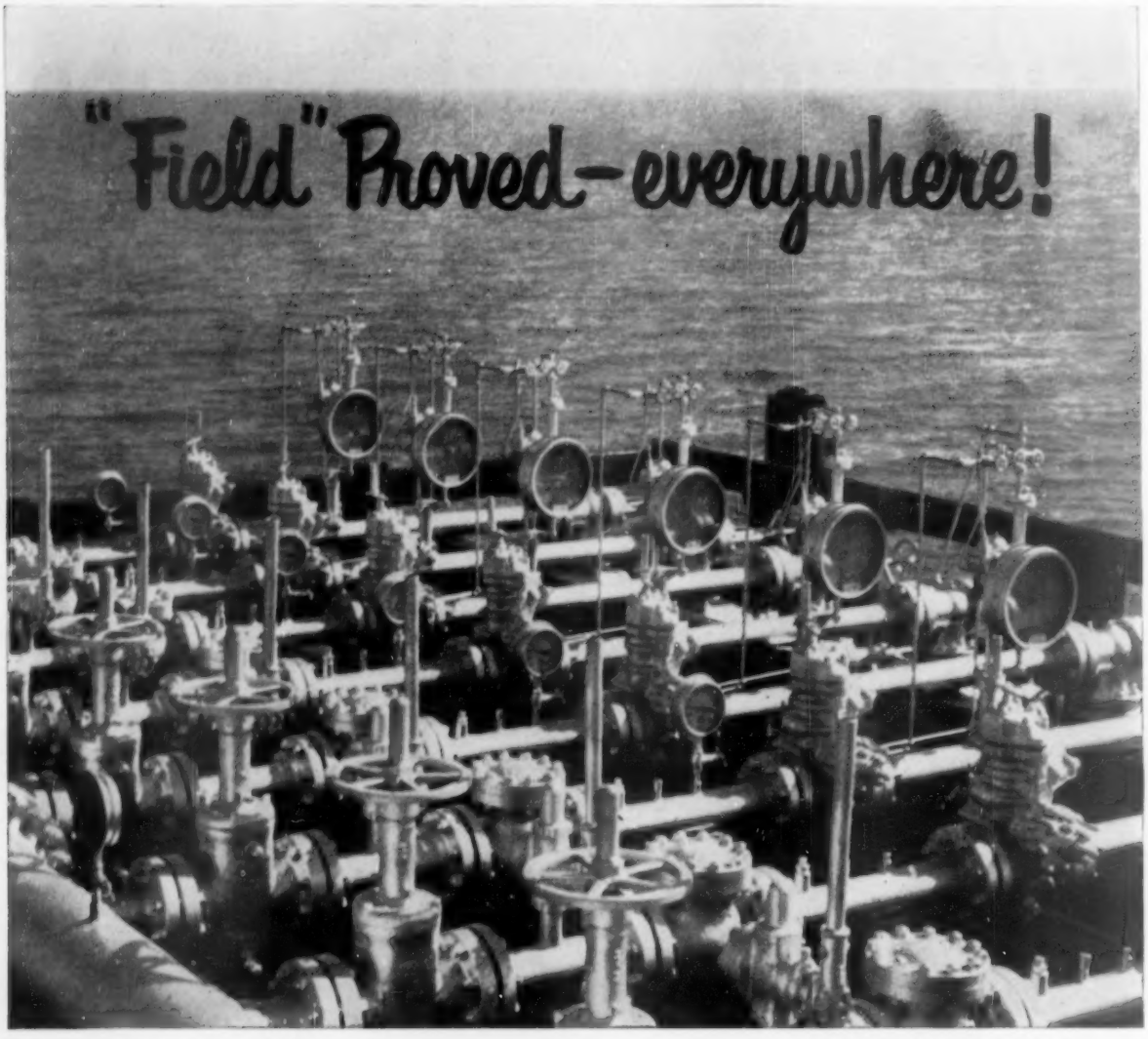
*Your nearest Clark representative will be pleased to give you all the facts.*

CLARK BROS. CO., OLEAN, N. Y.
*One of the Dresser Industries*
Offices in Principal Cities throughout the World

Clark Multi-Stage Centrifugal Compressors for process application




Clark Centrifugal Pipeline Booster for low ratios and high pressures




Foxboro Flow Meters get "sea-duty" measuring gas flow on platform in Gulf of Mexico. Well pressure is 1900 lbs.; pressure upsteam from chokes 800 lbs.; meter-run pressure 500 lbs.

## . . . Foxboro Flow Meters

Rugged, accurate, thoroughly dependable — whether they're measuring gas flow on an off-shore platform or on a wind-swept desert! That's the field performance record of Foxboro Flow Meters . . . the reliable, economical means of charting and prorating well production.

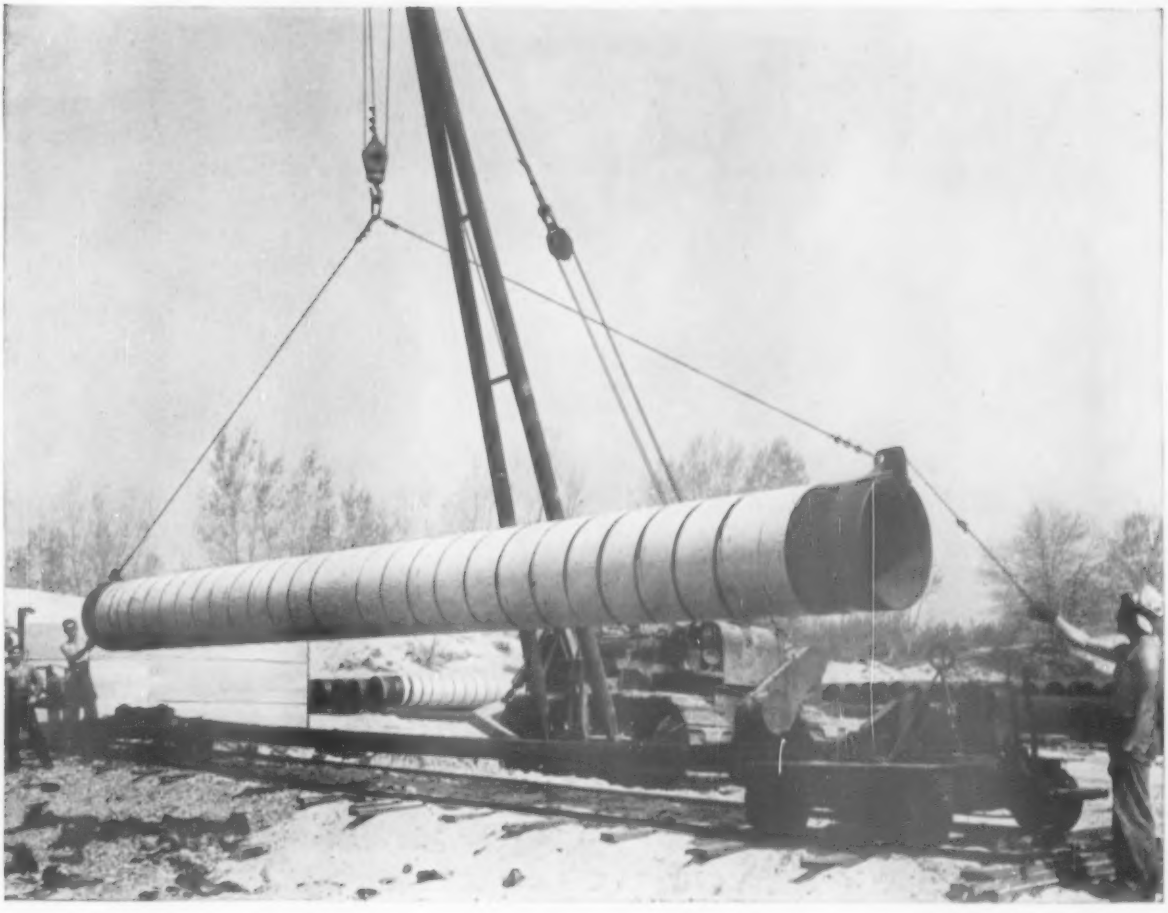
Basic "better-design" of these Foxboro Meters *assures* accuracy with essentially *no* maintenance! For example, transmission of float motion to the pen is *linear* — through the exclusive segmental lever drive and "life-lubricated" anti-friction bearing. There's no calibration compromise . . . no lost motion. And these are only a few of many engineered advances that pay off in troublefree gas measurement.

There are Foxboro Flow Meters for all production pressures. Especially adapted to field metering, the Type 22 is popular for working pressures to 2000 psi. The heavy-duty Type 26 is widely used for working pressures to 5000 psi. For complete details, write for Bulletin 460-2.

THE FOXBORO COMPANY, 605 NEPONSET AVENUE, FOXBORO, MASS., U. S. A.

FOXBORO REG. U. S. PAT. OFF. Oil and Gas FLOW METERS

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND



# ANOTHER LINK IN A MILLION-MILE CHAIN

This 30-foot section of pipe has been coated, wrapped, and is ready for service. It will take its place in the vast underground pipeline network that moves a greater volume than do trucks, railroads, ships and planes, combined.

It will become part of a great subterranean system that is vital to America's everyday living.

Let the facts speak for themselves. The gas industry alone handles over 10,000,000,000,000 cubic feet daily through more than half a million miles of transmission and distribution pipelines. A 185,000-mile pipeline system moves liquid petroleum products across the continent. In addition, there are many thousands of separate pipeline systems used to transport steam for power and heating —and to deliver water through municipal piping.

But there are problems—and one of the most important of these is corrosion. Pipeline companies and utilities must protect their metal pipe against the many corrosive elements that exist underground.

That's where Dearborn comes in. Dearborn's complete line of NO-OX-ID Coatings and NO-OX-IDized Wrappers provide both chemical and mechanical protection against moisture penetration and soil action—protection that lasts for decades—under ground or under water. That's why leading pipeline companies and utilities everywhere look to Dearborn for long-term protection against corrosion leaks and deterioration.

We will gladly consult with your engineers on the best NO-OX-ID Coating and Wrapper Combination for your next pipeline job.

SPECIFY

**Dearborn NO-OX-ID®**

ON YOUR NEXT PIPELINE JOB

USE THE COUPON FOR MORE INFORMATION

Dearborn Chemical Company, Dept. OG
Merchandise Mart Plaza, Chicago 54, Ill.

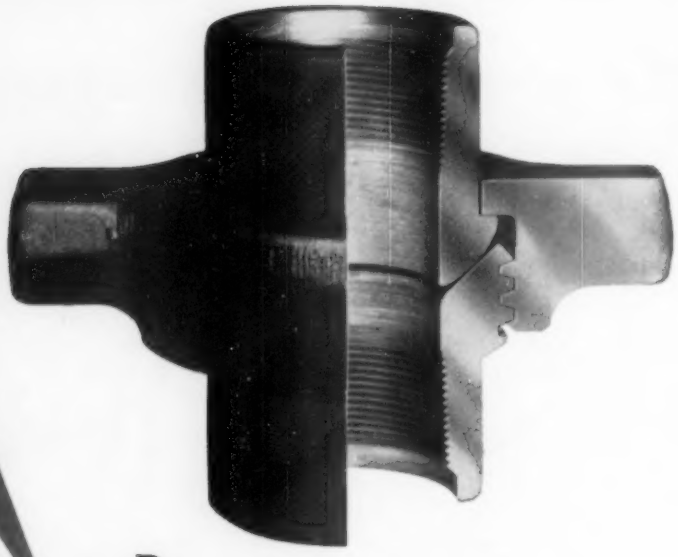
☐ Please send details on NO-OX-ID Combinations.
☐ Have representative call.

*Name*.....*Title*.....

*Company*.....

*Address*.....

*City*.....*Zone*.....*State*.....



*you're way ahead with*

# WECO UNIONS

**Way ahead in dependability** — *The famous ball and cone seat forms a positive metal-to-metal seal you can always depend on for a leak-proof seal.*

**Way ahead in service** — *WECO's tough wing nut, rugged Acme threads, and heavier wall sections are built to take rough treatment . . . to serve you month after month — on job after job.*

**Way ahead in economy** — *Repeated make-up and break-out does not affect the leak-proof seal of WECO unions — thus assuring you a union that lasts longer — costs less in the long run.*

**Way ahead in interchangeability** — *All parts of WECO Unions in the same size and pressure range are readily interchangeable. You never have to match and mate the same sub ends to get leak-proof connections — a time-and-money saving advantage whenever a rig is moved.*

**Way ahead in availability** — *You'll find WECO Unions at supply stores in all active oil producing areas — ready to do a better job — longer.*

U-17-55

WECO®

**WELL EQUIPMENT MFG. CORP.**

HOUSTON, TEXAS

Division of CHIKSAN COMPANY *a subsidiary of* FOOD MACHINERY AND CHEMICAL CORPORATION

# This is Why the Nash is the Most Simple Compressor

# *It's the Nash!*

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request

**No internal wearing parts.**

**No valves, pistons, or vanes.**

**No internal lubrication.**

**Low maintenance cost.**

**Saves floor space.**

**Desired delivery temperature automatically maintained.**

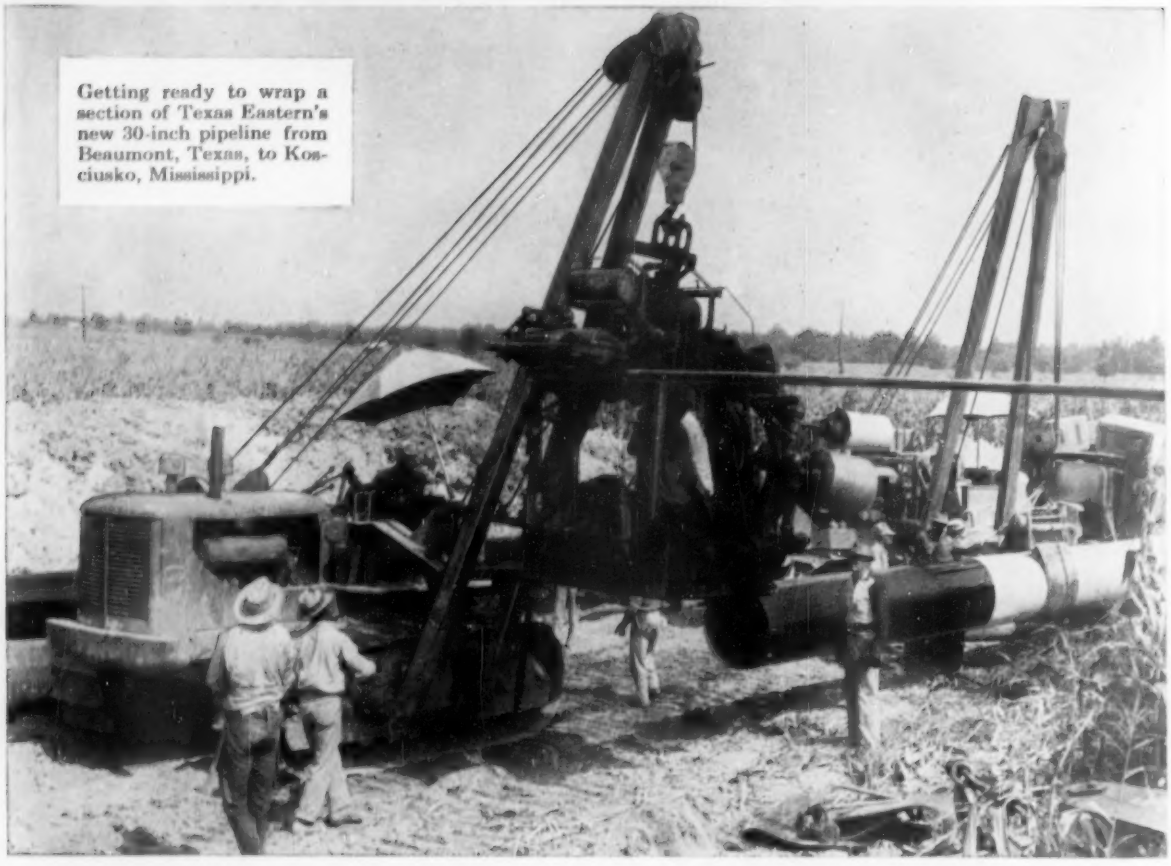
**Slugs of liquid entering pump will do no harm.**

**75 pounds in a single stage.**

**NASH ENGINEERING COMPANY**

**313 WILSON, SO. NORWALK, CONN.**

## PIPELINE news from L·O·F GLASS FIBERS COMPANY



Getting ready to wrap a section of Texas Eastern's new 30-inch pipeline from Beaumont, Texas, to Kosciusko, Mississippi.

# Texas Eastern used Blue Flag to help protect its new 30-inch pipeline

Companies with large pipeline investments know they can rely on L·O·F Glass Fibers' Blue Flag Reinforcing Pipe Wrap. A Blue-Flag-reinforced coating prolongs pipeline life years longer than unreinforced coatings . . . yet costs less than .5% of the original investment!

Here are other reasons why Blue Flag increases application efficiency, helps protect pipelines from corrosion . . .

- High tensile strength virtually eliminates breakage in the field!
- Uniform porosity allows hot enamel to bleed, and trapped gas to escape quickly—keeps "holidays" to a minimum!
- Retards cold flow of the enamel!
- Increases enamel strength!
- Helps protect coating from backfill damage!
- Made of special inert glass which resists action of soil chemicals.

Blue Flag Reinforcing Pipe Wrap is available from strategically located distributor warehouses. For full details, write *L·O·F Glass Fibers Company, Dept. 78-56 1810 Madison Avenue, Toledo 1, Ohio.*

L·O·F GLASS FIBERS
BLUE FLAG
PIPE WRAP

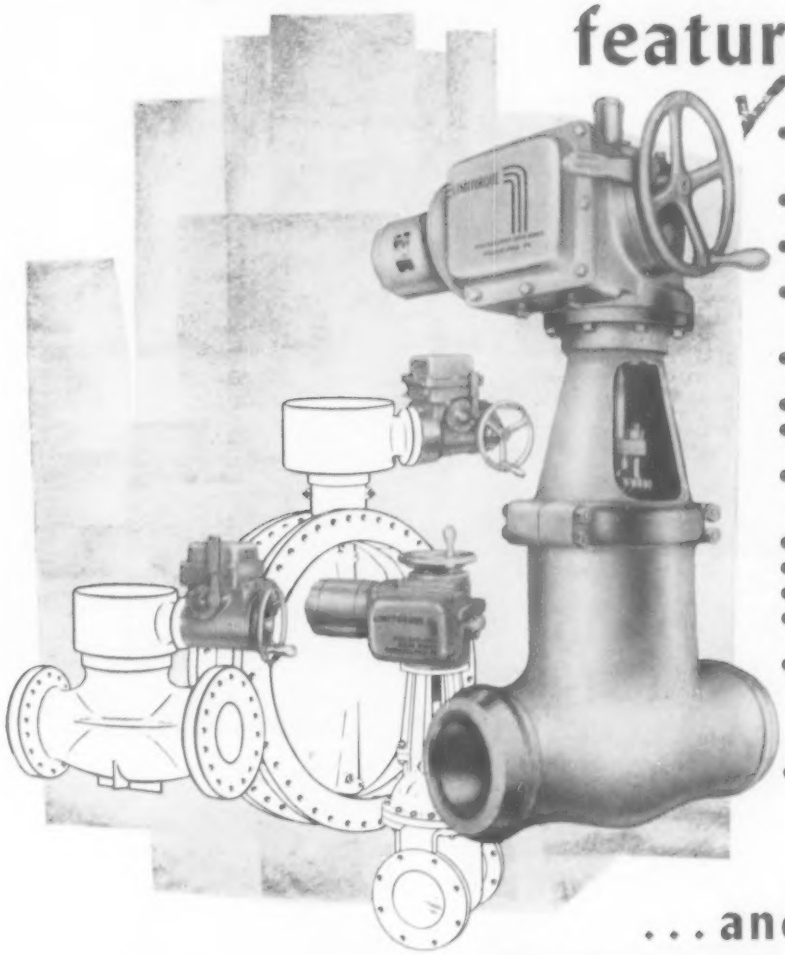
## L·O·F GLASS FIBERS COMPANY

**TOLEDO 1, OHIO**

Makers of glass fibers by the exclusive "Electronic-Extrusion" process

**For complete pipeline protection, use: BLUE FLAG** Reinforcing Pipe Wrap • **DURAMAT** Protective Outer Wrap • **DURAMESH** Pipeline Fabric • **DURATAPE** Pipeline Joint Wrap

# Check these features



- Micrometer torque seating switch gives tight valve closure, and protects valve parts from damage.
- Self contained unit—no gears, stem nut or bearings to buy.
- Weatherproof, dust-tight and water-tight construction.
- Hammerblow device . . allows motor to reach full speed, before load is engaged.
- Non-rotating handwheel built into the unit.
- Automatic declutching.
- Motor is disengaged during handwheel operation.
- Can always be declutched for handwheel operation regardless of weather or electrical conditions.
- High torque motors.
- Simple valve yoke.
- May be mounted in any position.
- Three to four times faster handwheel operation.
- Actuation may be by any available power source such as electricity, air, oil, gas, water or steam. LimiTorque is readily adapted for microwave control.
- LimiTorque is designed for plug, butterfly, gate and globe valves up to 96" diameter . . . Entire Unit and nut can be lifted off valve yoke, by removing flange bolts.

## . . . and you'll understand why more *LIMITORQUE* valve controls are in use than all others combined

Send for new catalog L-550, and please use your Business Letterhead when requesting.

**LimiTorque®**

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INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID AGITATORS • FLEXIBLE COUPLINGS

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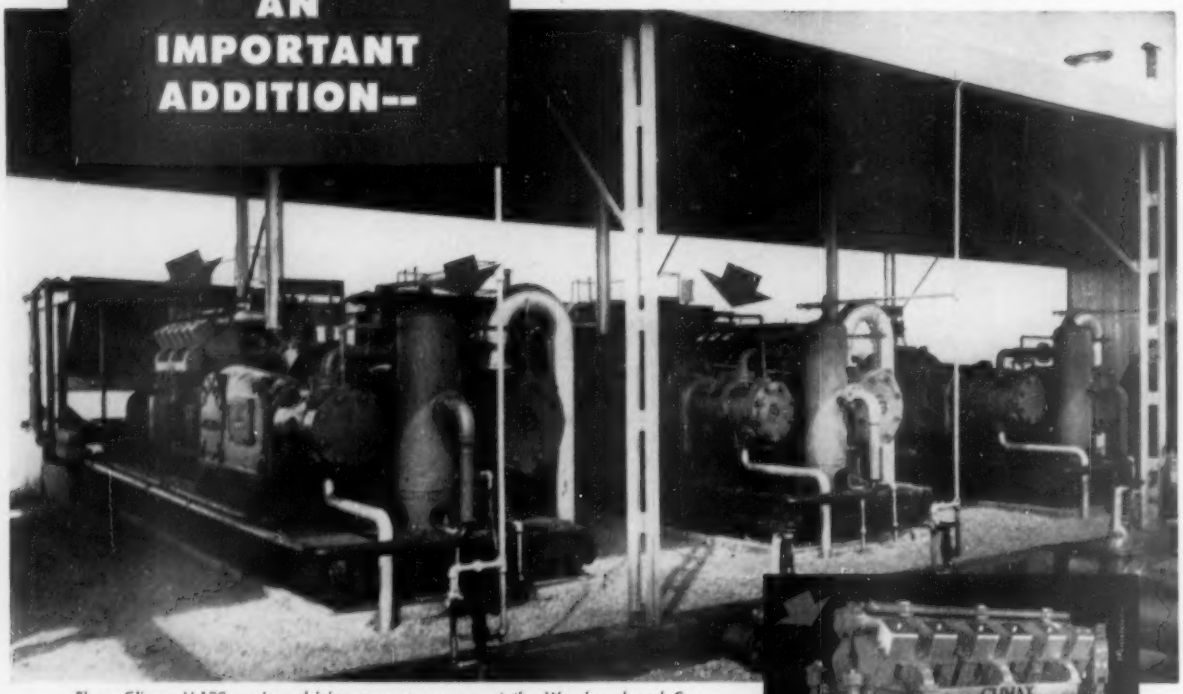
# AN IMPORTANT ADDITION--



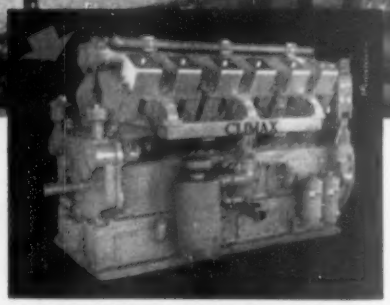
Three Climax V-122 engines driving gas compressors at the Woodward and Co. Gasoline Plant near East Washington, Okla.

## TO A *GROWING LIST* OF CLIMAX ENGINE INSTALLATIONS

**Climax heavy duty gas engines were selected to drive the compressors in Woodward and Company's new gasoline plant near East Washington, Oklahoma. This plant, having a design capacity of 3.5 million cubic feet per day, was engineered and constructed by Tinkham Engineering & Construction Company of Dallas, Texas, and includes three Model V-122 Climax engines driving Oil Well Supply DGE-250 gas compressors.**

**Rugged construction, modern design and a reputation for long service with maximum economy and minimum down time are features which make Climax engines outstanding wherever dependable power is required.**

**Climax engines are specially designed for compressor drive and are available in sizes from 100 to 350 H.P. for 24-hour round-the-clock service.**




A Climax V-122, 12 cylinder, 7 x 7 engine with a 3232 cubic inch displacement.

### OUTSTANDING FEATURES OF CLIMAX V & K SERIES ENGINES

- All models have renewable cylinder sleeves.
- All intake and exhaust valves are free-to-rotate type.
- All crankshafts are supported by bearings on each side of each crankthrow.
- All connecting rods are rifle drilled for pressure lubrication of piston pins.
- All cylinder heads have Climax high-turbulence type combustion chambers which produce maximum fuel economy.
- All models have the Climax consistent design that makes possible maximum interchangeability of wearing parts.

Write today for your copy of bulletin SA-611, "Special Power Units for Gas Compressors."

**WHERE POWER IS YOUR PROBLEM — CLIMAX IS YOUR ANSWER**

climax BLUE STREAK ENGINES

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**CLIMAX ENGINE AND PUMP MFG. CO.**
208 SO. LA SALLE ST. CHICAGO 4, ILL.
FACTORY • CLINTON, IOWA
DISTRICT OFFICE • 155 CONTINENTAL AVE., DALLAS 7, TEXAS

# GROVE FLEXFLO

## Regulators and relief valves give positive accurate control

- Control outlet pressure within narrow limits up to full rated capacity
- Positive bubble-tight seal unaffected by presence of foreign matter
- Quieter operation with no metal moving parts to chatter, slam or bang
- Less maintenance, with no sticking, friction, or corrosion problems
- Accurately controlled by a wide variety of manual or automatic pilots
- Proved in service with gas, air, water, oil and other fluid services
- Effective with temperatures to 150F and working pressures to 1500 psi
- Grove Flexflo Valves and Regulators available in iron or steel, 1" to 12"

The only moving part of the Grove Flexflo is an expansible tube which outlasts ordinary valve mechanisms many times over. Serving both as diaphragm and valve, it is instantly responsive, and closes tightly over scale or foreign matter without leakage or damage. For compactness, high capacity in relation to size, smooth sure control, and low maintenance, specify Grove Flexflo Valves and Regulators for pressure reduction, back pressure or relief services.

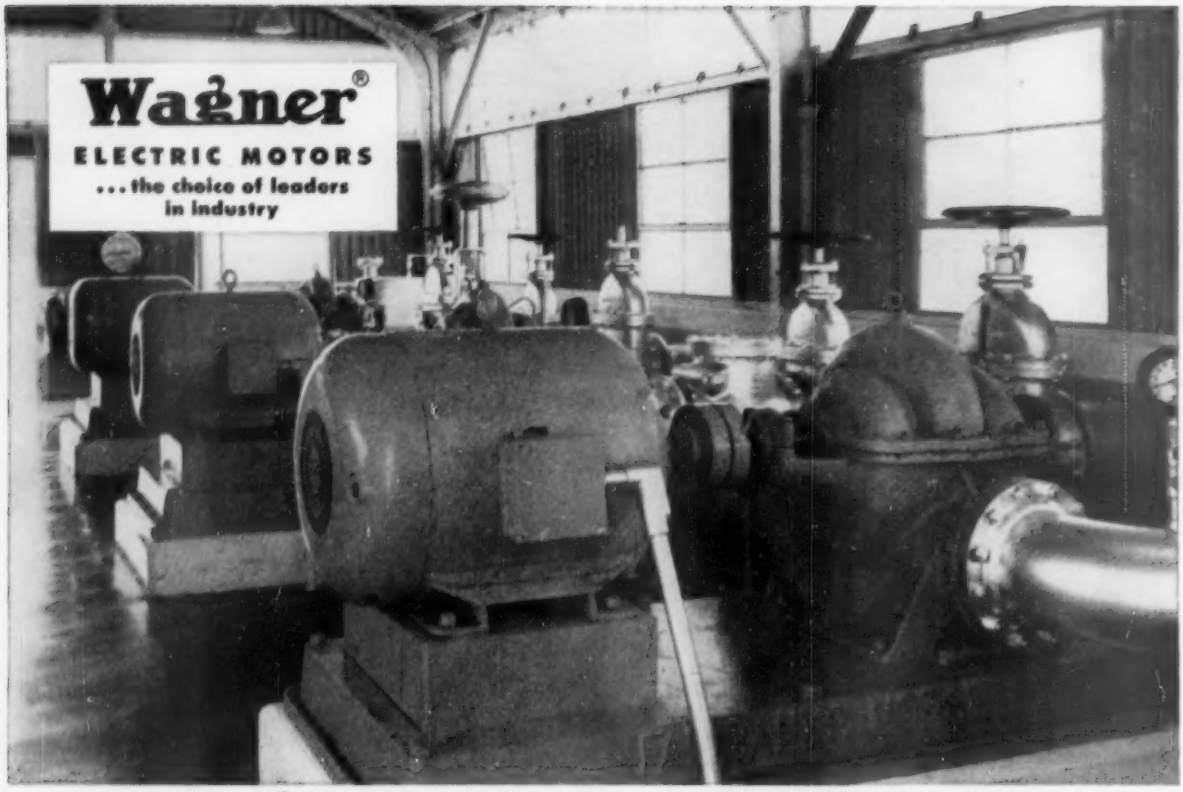
605

**GROVE FLEXFLO VALVES**

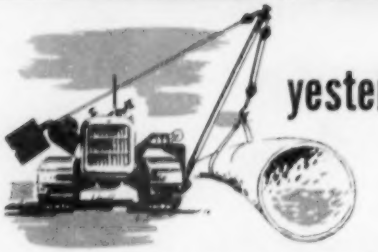
**GROVE VALVE and REGULATOR COMPANY • 65th & Hollis Sts., Oakland 8, California**
**HOUSTON 4**—1901 Calumet St. • • • • • • • • **LOS ANGELES 6**—1930 W. Olympic Blvd.

ODESSA, TEXAS • TULSA, OKLAHOMA • DENVER, COLORADO • In Western Canada: GROVE VALVE LIMITED

GROVE SIMPLICITY ACCURACY SAFETY




These 50 hp Wagner Motors drive jacket water pumps in TGT's main line gas booster station at Batesville, Mississippi



## yesterday's pipe dream . . . today's miracle

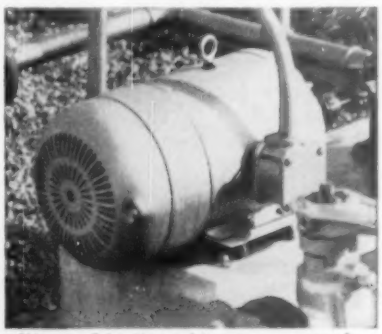
Like a giant artery, the Tennessee Gas Transmission Company's 2200-mile pipeline stretches from the heart of the natural gas fields underneath the plains of South Texas and Louisiana to the thickly-populated industrial East.

To give more convenience to the busy homemaker, to help teeming factories produce more goods—the tremendous volume of a billion-and-a-half cubic feet of natural gas moves through this underground highway each day.

In the last ten years TGT has increased eight-fold the capacity of its natural gas pipeline system and its installed compressor horsepower.

The Wagner Electric Corporation has had a hand in the expansion of such gas transmission systems. You'll find Wagner transformers at work in field processing plants. At booster stations, you'll find Wagner motors busy at their never-ending job of pumping, pumping, pumping . . . and, motors that drive pumps need plenty of electrical and mechanical stamina to hold up under the hard, steady grind.

Whether it's a job of pumping gas or any one of hundreds of other industrial operations . . . Wagner products can do the job economically and well. Wagner engineers are qualified to specify the correct transformers and motors for *your* requirements. Consult the nearest of our 32 branch offices, or write us.



Wagner 5 hp Motor drives a sump pump in gas booster station, Batesville, Mississippi

**Wagner Electric Corporation**
6389 Plymouth Ave., St. Louis 14, Mo., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

WM55-5

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

**Transportation.** The Universal 'Jeep'* and the 4-Wheel-Drive 'Jeep' Station Wagon, with the extra traction of their 4-wheel drive, take supervisors, work crews or tool-pushers and their equipment and supplies almost everywhere on the lease, road or no road, up 60% grades, through water 2 feet deep . . . wherever they have to go, in good weather or bad.

# How 'Jeep' all-wheel traction speeds oil and gas operations!

**Pipeline Construction.** The 'Jeep' Truck is the only time-tested and performance-proved 4-wheel drive truck in its weight class. It carries a payload 63% of its curb weight or tows heavily loaded trailers to pipeline construction areas ordinary vehicles can't reach.

**Exploration.** With the extra traction of its 4-wheel drive, the Universal 'Jeep' travels remote terrain for prospecting and exploration. In good weather or bad, it takes geologists, crews, equipment and tools almost anywhere in rugged country.

The oil and gas industry pioneers far ahead of roads. It needs the extra traction of rugged 4-wheel drive 'Jeep' vehicles to get through where ordinary vehicles can't, to stay on the job and keep work moving smoothly and on schedule, in good weather or bad.

'Jeep' vehicles are the only 4-wheel drive vehicles in their weight class designed and engineered completely for 4-wheel drive off-the-road use.

For exploration and prospecting . . . on the lease . . . along the pipeline . . . versatile 'Jeep' vehicles carry men, tools and equipment through mud, sand, soft earth, over the roughest terrain. With power take-off, they provide on-the-spot power to operate many types of equipment, from mobile drills to winches. They haul heavily loaded trailers on the road or off. And they shift easily into conventional 2-wheel drive for highway travel at top legal speeds.

Billions of miles of use prove that 'Jeep' vehicles spread their cost over many jobs . . . provide additional savings through long life, low maintenance costs and high resale value. Ask your Willys dealer for an on-the-job demonstration today.

The 'Jeep'®

**family of 4-Wheel-Drive vehicles**

**WILLYS . . . makers of the world's most useful vehicles**

*Model CJ-5 shown

WILLYS MOTORS, INC., TOLEDO 1, OHIO

# REPUBLIC SRK

## . . . a tough, corrosion-resistant plastic pipe

**Long life...plus ease of installation will cut oil piping system costs...**

Oil piping system operators now using Republic SRK (Semi-Rigid Kralastic) in their crude and brine pipelines have discovered real savings in transportation, installation and maintenance costs.

Principal reason lies in the unique advantages of this rugged pipe—advantages unmatched by any other pipe material.

*It's easy to transport*—because Republic SRK is extremely lightweight, one man can carry several lengths with little effort. And once made up, he can ditch the pipe by himself.

*It's easy to install*—Republic SRK can be installed quickly and easily—even by workers with no previous experience in laying plastic pipe. Any ordinary handsaw will cut it. And it takes only seconds to join permanently

**REPUBLIC**

REPUBLIC STEEL

*World's Widest Range of Standard Steels*

# with amazing endurance

with a brush-applied welding solution. This speed of assembly keeps installation costs down.

*It's easy to maintain*—Republic SRK's high resistance to corrosive oils and salt water guarantees long life—fewer replacements. A carbon black additive makes it resistant to deterioration from the sun's ultraviolet rays.

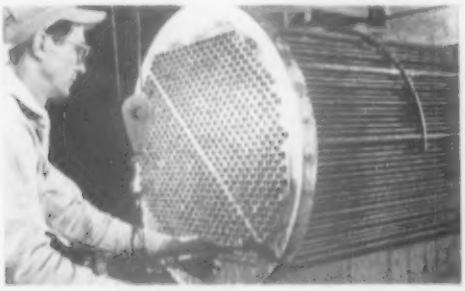
Because it's extremely tough, Republic SRK will stand up under rough treatment. Impact strength is high—and over a wide range of temperatures. Sizes range from ½" to 2"—150 lbs. PSI; 2" through 6"—100 lbs. PSI; 3" through 6"—75 lbs. PSI.

Republic also makes Semi-Rigid Butyrate (SRB) for areas where paraffin conditions are extremely severe. It will pay you to investigate both Republic SRK and SRB. To get the complete story *send coupon today.*

**STEEL**

*and Steel Products*

**ENDURANCE AND SAFETY** are features of Republic Alloy Spinning Chain. Made from high-quality Republic Alloy Steel, it stands up under the most abusive wear. It's heat treated to make it tough and resistant to shock, abrasion and cold working. Provides a good grip for fast spinning. A visible safety warning is its ability to elongate well in excess of minimum requirements before breaking. Send coupon for more information.



**ENDURANCE AND UNIFORMITY** make Republic ELECTRUNITE® Heat Exchanger Tubes ideal for use in condensers and heat exchangers. Republic's high standards of quality control assure users of unsurpassed performance and long life. Full normalizing of every length results in uniform ductility. Wall thickness is uniform with no longitudinal thin spots. You'll get more production—less down time with dependable Republic ELECTRUNITE Tubes.

**ENDURANCE AND DEPENDABILITY** are what you buy with every joint of Republic Electric Weld Casing and Tubing. Uniformly thick skelp is welded into a tube of uniform roundness, fully normalized, then cold sized. Clean, full-formed threads protect your investment. Available in grades H-40, and J-55, in sizes ranging from 2⅜" through 13⅜" O.D. Sold by your Republic Oil Country Distributor.

**REPUBLIC STEEL CORPORATION**
**Dept. C-1539**
**3112 East 45th Street, Cleveland 27, Ohio**

Please send me more information on:
☐ Kralastic Plastic Pipe ☐ Chain ☐ Casing and Tubing
☐ ELECTRUNITE Heat Exchanger Tubes

Name_____ Title_____
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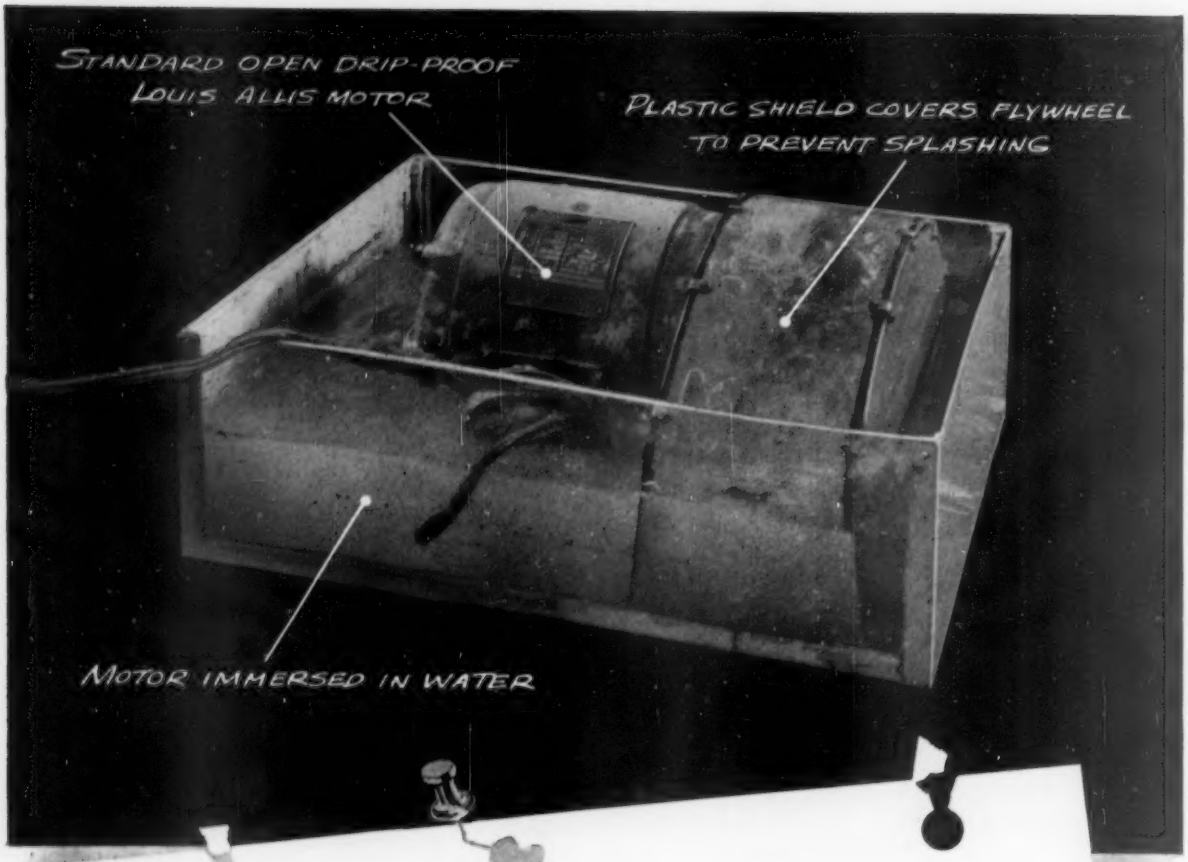



# *In water 1½ years...still running*

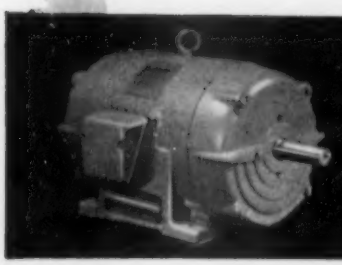
## Dramatic proof that Louis Allis motor insulation provides unusual moisture resistance

We wouldn't do this to a motor. But somebody did, to check our new insulation. They took a standard open drip-proof motor, placed it in water up to the shaft, and ran it a year and a half.

The motor will still run, too, which proves that our insulating materials are of top quality. One of our exclusive features is the new phenolic impregnating varnish we use. As you can see, this varnish resists moisture, but it also has excellent thermal and chemical resistance and is not susceptible to embrittlement.

Insulation usually determines the life of a motor. That's why the insulating materials used in the new L. A. line are the product of years of continuous research and development. That's why Louis Allis motors run longer . . . give less trouble.

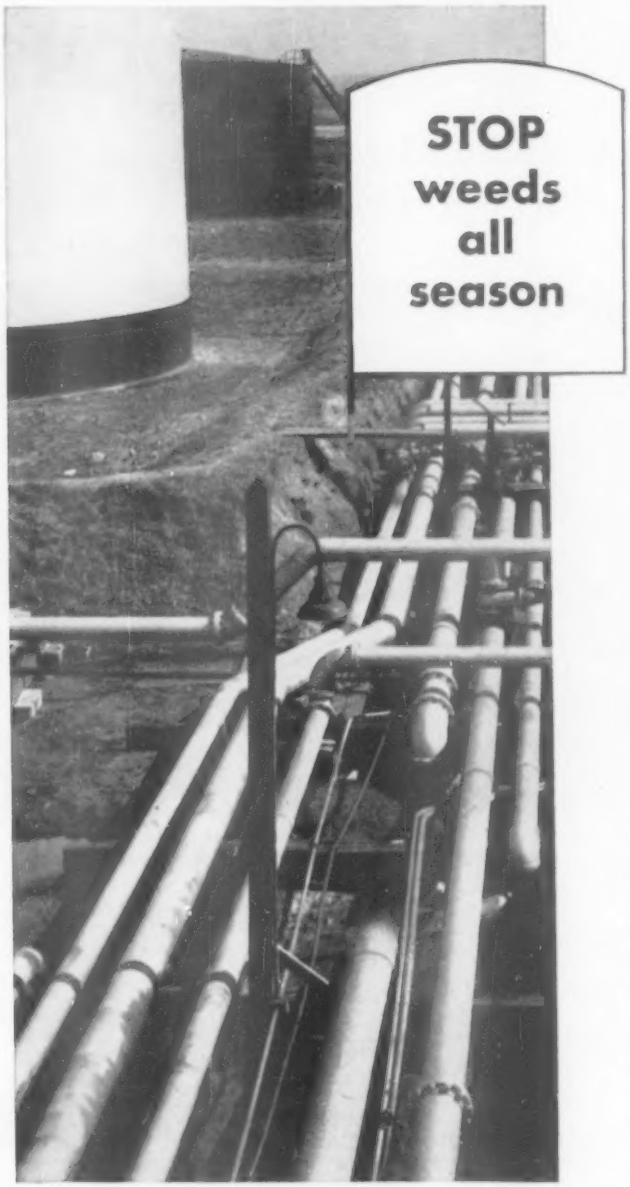
Find out the many other advantages available to you in the new L. A. line of motors. Write for our new bulletin No. 1700.



A complete line of standard rerated motors in frames 182 through 326U now in stock. Special rerated motors are available on short delivery.

LA-107

**THE LOUIS ALLIS CO.**
MILWAUKEE 7, WISCONSIN




**Still weed-free one year after treatment with "Telvar."** The area around the tanks and pipeline was sprayed with a single treatment of "Telvar" a year before this photo was taken. Weed-control costs are cut with "Telvar" because it gives thorough, long-term weed control.

**FREE ILLUSTRATED BOOKLETS** describe how to control weeds and brush with Du Pont chemicals. Write to Du Pont, Grasselli Chemicals Dept., Rm. D-4032, Wilmington, Del. In Canada, Du Pont Company of Canada Limited, 80 Richmond Street West, Toronto, Canada.

# Spray just once with Du Pont TELVAR®

WEED KILLERS

When you use "Telvar" weed killers, vegetation is killed through the roots and regrowth is prevented because the chemical remains in the soil . . . provides residual action all season long. And low dosages (1 to 1½ lbs. per 1,000 sq. ft.) make it cost little for the results you obtain. Such low rates also mean less handling, less use of storage facilities.

"Telvar" weed killers come as wettable powders, are non-corrosive, non-flammable, non-volatile, low in toxicity to humans and livestock.

Include "Telvar" weed killers in your weed-control program this year. Prove to yourself how these products of Du Pont research can help cut your maintenance cost to new low levels.

• • •

**Where brush is a problem,** Du Pont Ammate® X weed and brush killer is the product you need. It kills more kinds of brush with unusual safety. With ordinary precautions, "Ammate" X may be used close to such crops as cotton, tomatoes, soybeans and peanuts.

On all chemicals, follow label instructions and warnings carefully.

DU PONT
REG. U.S. PAT. OFF.

**WEED and BRUSH KILLERS**

BETTER THINGS FOR BETTER LIVING...*THROUGH CHEMISTRY*

# More than 325,000 horsepower of

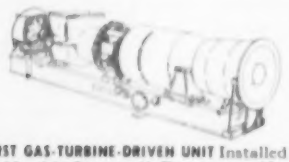
# CENTRIFUGAL COMPRESSORS

## for NATURAL GAS SERVICE

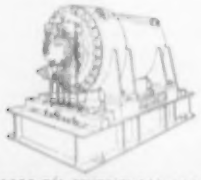
### I-R *"FIRSTS"* in Centrifugal Gas Compressor History

**FIRST CENTRIFUGAL PIPE-LINE COMPRESSOR** Built by Ingersoll-Rand in 1931, this centrifugal pipe-line booster consists of a six-stage compressor driven by a 3550 rpm, 3000 hp motor, all encased in a pressure vessel.

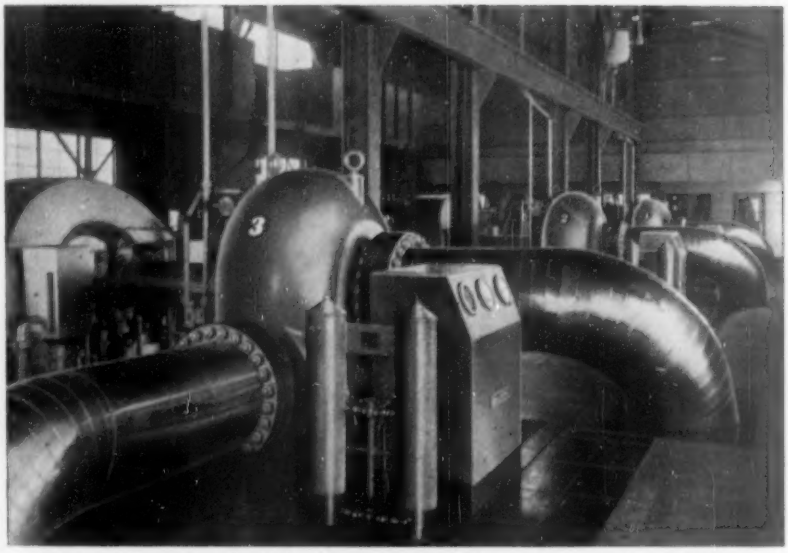
**FIRST COMMERCIAL APPLICATION** of centrifugal pipe-line compressors was made in 1947. A total of 78 electric-motor-driven, single-stage I-R centrifugals were installed, to handle approximately 250 mmcfd.



**FIRST GAS-TURBINE-DRIVEN UNIT** Installed in 1949, this Ingersoll-Rand centrifugal compressor, powered by an 1850 hp simple cycle combustion gas turbine, was the first gas-turbine-driven centrifugal compressor developed and applied to pipe-line service, and was designed for a flow of 192 mmcfd at a ratio of 1.18.



**FIRST 2000 PSI CENTRIFUGAL GAS COMPRESSOR** This Ingersoll-Rand 5000 hp double-case centrifugal compressor was the first unit ever built for handling natural gas at a discharge pressure of 2000 psi.



Three of 8 Ingersoll-Rand centrifugal compressors installed on a large natural gas pipe-line. Each unit is driven by a 5000 hp gas turbine.

### *This experience means MAXIMUM DEPENDABILITY in modern pipe-line service*

FROM the very first pipe-line installation, Ingersoll-Rand has pioneered in the development of centrifugal gas compressors for higher and higher capacities and pressures. And every step of the way, dependability of performance has been a prime consideration in every detail of design and construction. This is why more I-R Centrifugal Compressors have been sold for natural gas service than any other make . . . . a total exceeding 325,000 hp for this service alone.

Backed by such long and successful experience, the modern I-R centrifugal gas compressor is your best assurance of trouble-free performance and long-range economy in gas transmission service.

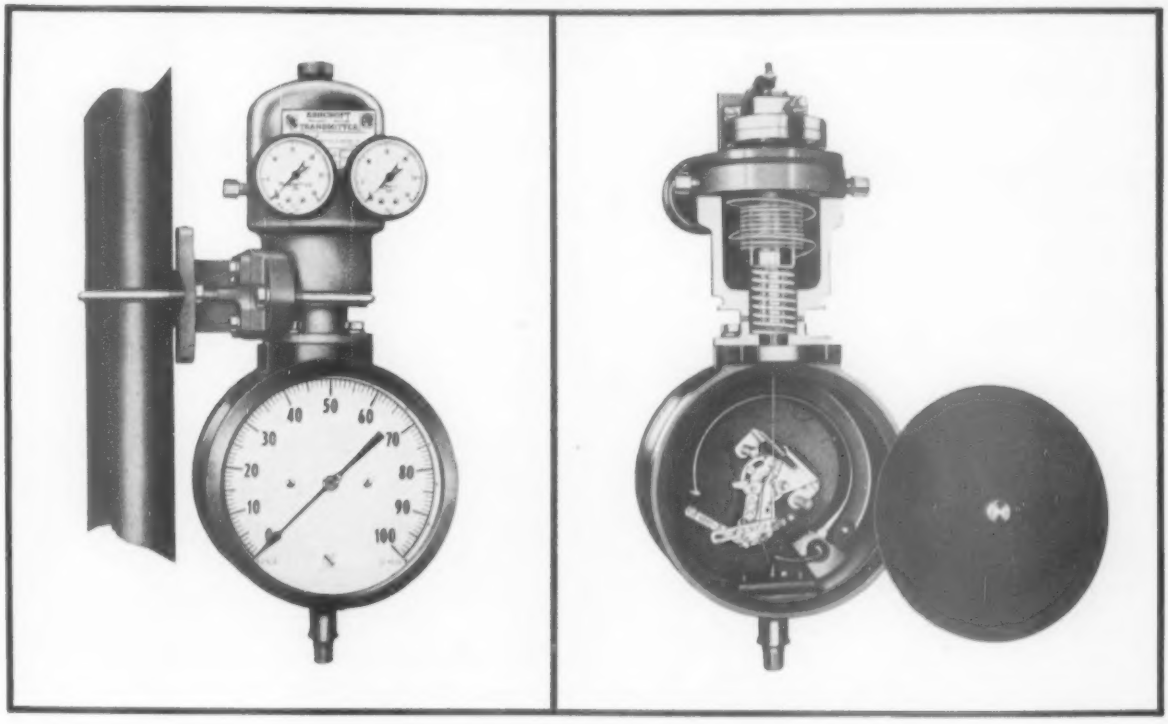
**Ingersoll-Rand**

11 Broadway, New York 4, N. Y. 12-319

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO-BLOWERS CONDENSERS
CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

*Designed to* solve safety and service problems

# ...THE NEW ASHCROFT PNEUMATIC PRESSURE TRANSMITTER



This new Ashcroft Pneumatic Pressure Transmitter is particularly recommended to processing industries and power stations. It combines speed and accuracy with maximum protection and serviceability.

The new design features the 6" indicating Ashcroft Maxisafe Duragauge, long known for dependable performance. It has an integrally-cast solid metal wall between dial and pressure sensitive element so that the transmitter can measure pressures up to 100,000 psi with complete safety for personnel and equipment. If misapplication ruptures the Bourdon tube, the Teflon-coated back cover serves as a safety blowout relief.

Another outstanding design advantage is easy access to both gauge and transmitter sections. Simply remove the safety-relief back cover and both the gauge and transmitter can be calibrated. Yet a sealed housing makes the entire assembly weatherproof.

The transmitter operates on low-pressure air. No need for expensive high-pressure lines and fittings. Supply air pressure as low as 18-20 psi for 3 to 15 psi output provides especially advantageous operation where electrical wiring might be a hazard. Inflammable, poisonous or corrosive liquids or gases are confined close to their source, away from the central control point.

The Series 1250 Ashcroft Pneumatic Pressure Transmitter is available with pressure sensing elements in all standard pressure ranges and Bourdon tube materials. Installation of the transmitter is easy. Small diameter tubing may be used, and the pipe, stem, wall or flush mounts are interchangeable in the field. Get complete operational data and construction details. Write for Bulletin 340.

**YOUR INDUSTRIAL SUPPLY DISTRIBUTOR** has the broad knowledge and thorough experience essential to satisfy every requirement of your Ashcroft Pneumatic Pressure Transmitter application. You get fast, economical service from his local stocks.

**In Canada:** *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

## ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

ONE OF A SERIES . . .

# What makes a cylindrical roller bearing good?

# SUPERIOR QUALITY of INNER RACES

**The function of an inner race is to provide a fatigue-resistant surface between a shaft and the bearing rollers. Because of roller bearing geometry, there is a smaller area of contact between inner race and rollers than between outer race and rollers. This concentrates more load on the inner race and makes it the critical member from a fatigue life standpoint, particularly when the inner race is the stationary member and maximum load is repeatedly applied at one point.**

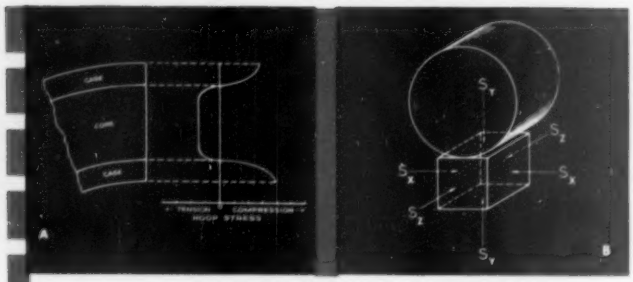
**Since it is vital to good performance that the inner race does not work loose on the shaft, HYATT inner races are designed for relatively heavy press fits, so the inner race becomes an integral part of the shaft for all practical purposes. Other advantages of HYATT'S carburizing process and precision finishing operations are briefly explained at right.**

**You'll find more details in HYATT General Catalog No. 150, or your nearby HYATT Sales Engineer will gladly help you choose the type best suited to your design requirements. Remember, HYATT is America's *first* and *foremost* maker of roller bearings. Hyatt Bearings Division of General Motors Corporation, Harrison, New Jersey.**

GM GENERAL MOTORS

HYATT

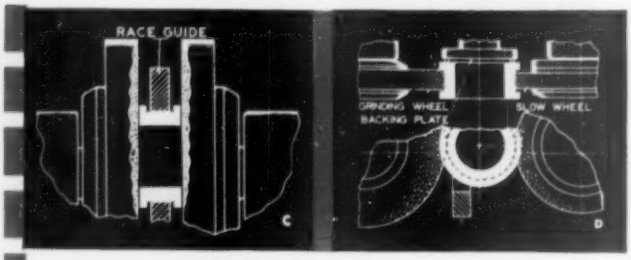
ROLLER BEARINGS




1. WHY CARBURIZING?

Carburizing provides inner races with tough cores, and flanges that will not crack, with no loss of case hardness. This permits tight press fits and also improves load-carrying capacity as shown in Diagram A. During quenching, a volumetric change tends to stretch the core and compress the case. Due to the Poisson effect, the compressive hoop stresses in the external fibres build up the load-carrying capacity.

Diagram B shows a typical element under roller load. Stresses in the "Z" direction are negligible; those in the "X" direction are compressive hoop stresses or pre-load. Those in the "Y" direction are compressive stresses due to the load. Without the compressive stress Sx (hoop stress) the load capacity would be reduced; and if "X" were a tensile stress due to pressing a through-hardened race on a shaft, the bearing capacity would be still less.

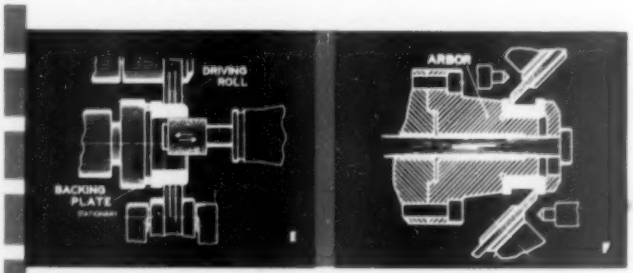



2. DOUBLE END GRIND

In grinding a HYATT inner race, the ends are first faced off square and parallel so they can be used as accurate reference during subsequent operations. The HYATT double end grind process (Diagram C) insures excellent control of parallelism.

3. CENTERLESS PATHWAY GRIND

Centerless grinding was pioneered by HYATT years ago, and eliminates excessive wall variation due to spindle and chucking errors. This method produces as nearly a perfect cylinder as is commercially practical. Two-point and three-point out of round and taper are held to a minimum. Note how work is rotated with backing plate against previously ground end (Diagram D) to insure accuracy.




4. CHUCKLESS BORE GRIND

Here the centerless method assures a bore concentric with the pathway, with minimum wall variation, by removing stock from high spots as they pass between drive roll and related grinding wheel (Diagram E).

5. FLANGE GRINDING

To assure that they will run true with roller pathway, flange faces are also ground using the squared ends for reference (Diagram F). This establishes even contact with roller ends during bearing operation.

# 55 MILES SOUTHWEST OF NOWHERE!

Miles of waste land often separate wells from the nearest source of supply . . . miles that present almost insurmountable transportation problems . . . even greater maintenance problems. In these cases, Southwestern Plastic Pipe has proved itself time and again.

Southwestern Plastic Pipe is light weight, easy-to-transport, easy-to-handle, easy-to-install. Fewer men and less time are required for installation. With rust, rot and electrolytic corrosion eliminated, maintenance problems are reduced to a minimum.

Wherever your wells are located, investigate Southwestern Plastic Oil Field Pipe. You'll find real economy now, but even more important, you'll save maintenance expense for years to come.

Write today for full information on Southwestern Plastic Pipe. You'll receive descriptive literature on several types of Oil Field Pipe manufactured by Southwestern . . . each type designed to do specific jobs better. Mail the convenient coupon now.

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I am interested in Southwestern Plastic Oil Field Pipe. Please send full information on the following uses. No obligation, of course.

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Southwestern Plastic Pipe Co. A Div. of Texas Vitrified Pipe Co. P. O. Box 117 Mineral Wells, Texas Phone 3050

IT'S NEARING COMPLETION...
PACIFIC NORTHWEST PIPELINE'S
"SCENIC INCH"

Winding across New Mexico's deserts, climbing the snow-capped Colorado Rockies and ending at last in the evergreen country of Oregon and Washington . . . Pacific Northwest Pipeline Corporation's 2300-mile "Scenic Inch" is being rushed to completion.

This $209,000,000 pipe line project will soon deliver over 343,000,000 cu. feet of natural gas per day to aid the expanding economy of the Northwest.

*Working closely with Pacific Northwest Pipeline Corporation on the "Scenic Inch" is Kaiser Steel—a major supplier of line pipe on this project.*

Next time you are ordering line pipe, think of Kaiser Steel. Rely on Kaiser Steel quality and service to add dollars to your operating profits.

Kaiser Steel

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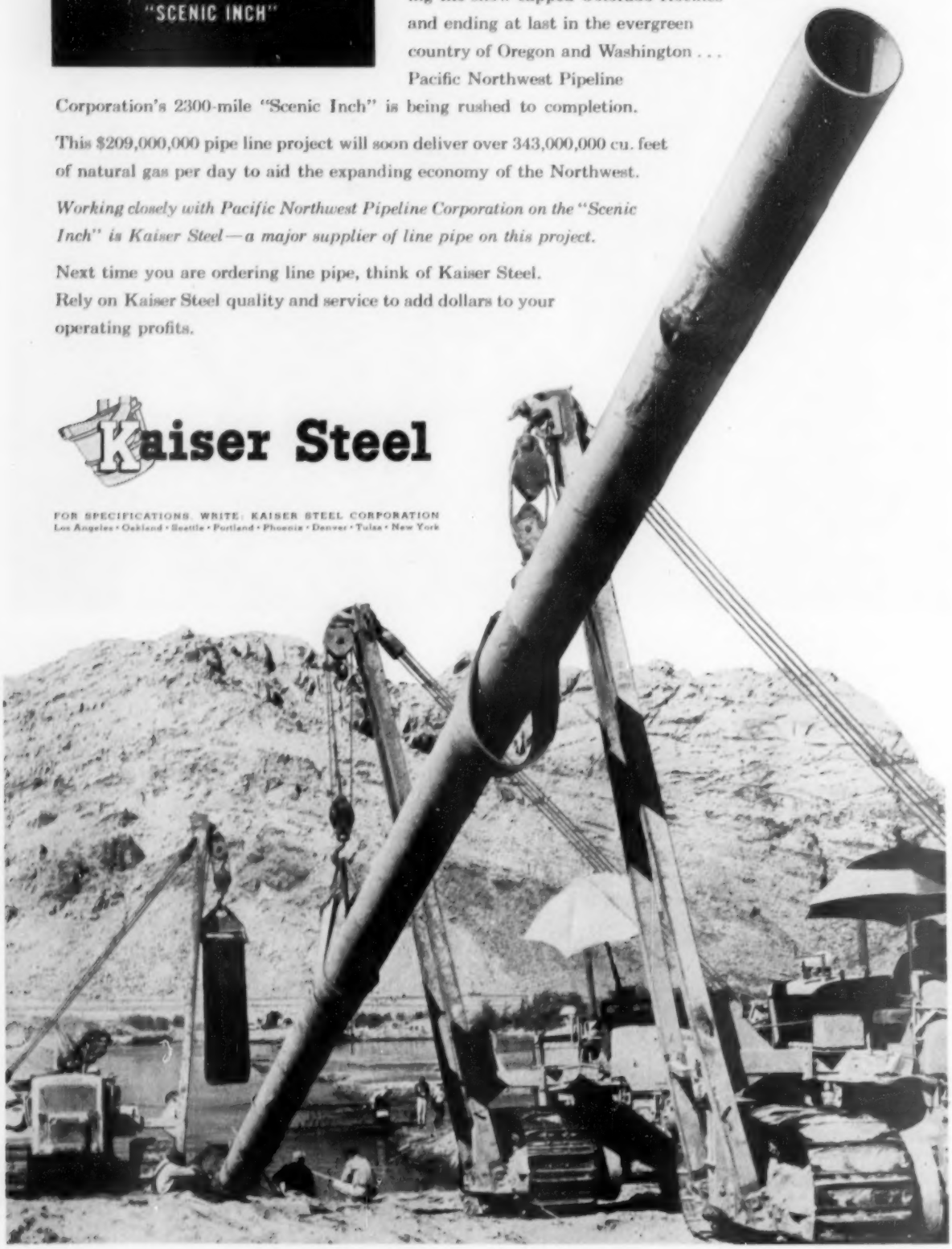

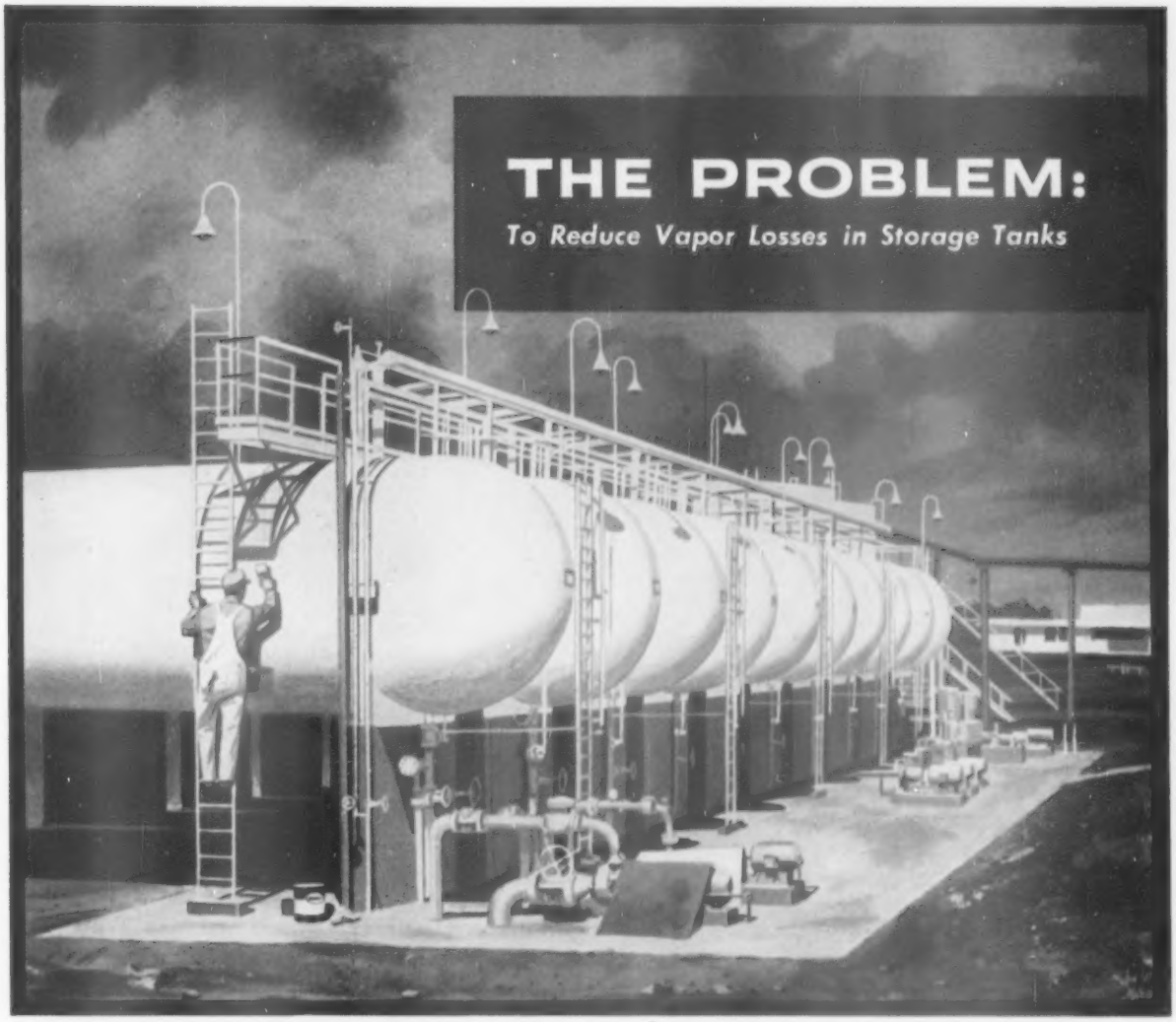


# THE SOLUTION : *Humble's Light and Heat Reflective* **Exterior White Enamel 460**

The light and heat reflective properties of Humble's Exterior White Enamel 460 effectively reduce vapor losses from such highly volatile products as LP Gas and gasoline by reducing interior temperatures in storage tanks. When it is applied over a Rust-Ban priming system, you also get superior protection against extreme weathering and corrosive fumes, plus good color and gloss retention.

Humble produces a complete line of protective coatings—Rust-Bans, paints and enamels, each designed for a specific task.

For more information on Humble protective coatings, see your nearest Humble wholesale plant in Texas and New Mexico, or write or phone:

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**Humble Oil & Refining Company,**
**P. O. Box 2180, Houston 1, Texas.**

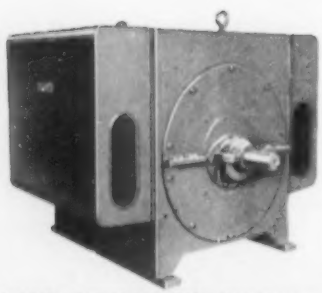
**HUMBLE**

HUMBLE OIL & REFINING COMPANY

LOOK BEHIND THE "INSULATION CURTAIN" BEFORE YOU SELECT A LARGE MOTOR

# Every Elliott stator takes a plunge in the motor industry's largest "dip tank"

Here is another reason why Elliott Induction Motor coil insulation has proven so successful. *Every large induction motor stator, regardless of size,* is completely submerged in specially selected flexible varnish. This completely saturates the stator winding and provides an additional rust-inhibiting coating to metal parts. After baking to a prescribed process, the coil end turns, leads and joints are given two subsequent dips and bakes. This provides additional assurance against the entrance of moisture, chemical fumes, dust, etc. This is a big plus in the long list of Elliott "extras" in insulation that have contributed to an outstanding record of *not one failure due to insulation* in over 1,400,000 hp of large squirrel-cage induction motors installed through the country during the last 7 years. These motors are serving all over, both indoors and out – in utilities, oil refineries, chemical plants, metal mills, atomic energy plants, shipyards, paper mills, etc. For full facts, ask your Elliott field engineer or write Elliott Company, Ridgway Division, Ridgway, Pa.



**ELLIOTT WEATHER-PROTECTED MOTORS** have a perfect seven year success record of no stator failures due to faulty insulation. The only weather-protected motor which can make such a claim.

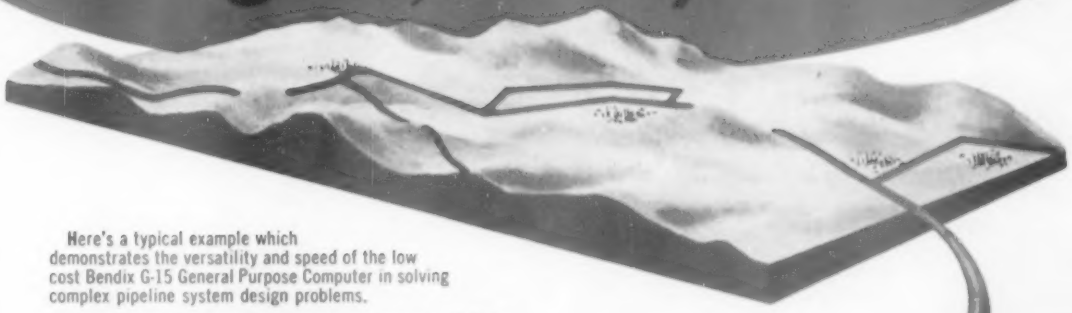
RG-11

**ELLIOTT Company**

*Elliott large motor insulation is "field-proven"*

# GIVES THE ANSWER TO PIPELINE DIFFERENTIAL PRESSURES...IN SECONDS!

## Bendix Computer



Here's a typical example which demonstrates the versatility and speed of the low cost Bendix G-15 General Purpose Computer in solving complex pipeline system design problems.

A proposed system of pipelines 160 miles long with 1800 feet variation in altitude, was to consist of a number of pipes of different diameters running in parallel over eleven given sections. At the end of the sections, gas was to enter the flow from another source or be branched off to another destination. In addition, two compressors were to be placed at various sections along the line.

### 6 SECONDS TO SOLVE EACH STATION

After the problem has been entered into the Computer only 6 seconds per section are required to solve and print the answer for each station, giving pipeline pressure, flow rate of the gas and the mile posts.

In addition, the Computer requires only 8 seconds to provide the following for each compressor calculation: fuel used, brake H.P., sea level H.P., compression ratio, suction pressure and discharge pressure.

The Bendix G-15 is an entirely new concept in electronic computation. Its unusually low cost, large capacity and speed make it an economically sound investment for research, engineering and control functions, even for so-called "small' company operations.

Let us send you complete information on how the Bendix Computer can effectively serve you.

Bendix Computer

**Bendix Computer Division, Bendix Aviation Corp.**
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Tell us how we can economically use the Bendix Computer in our engineering, research and control functions.

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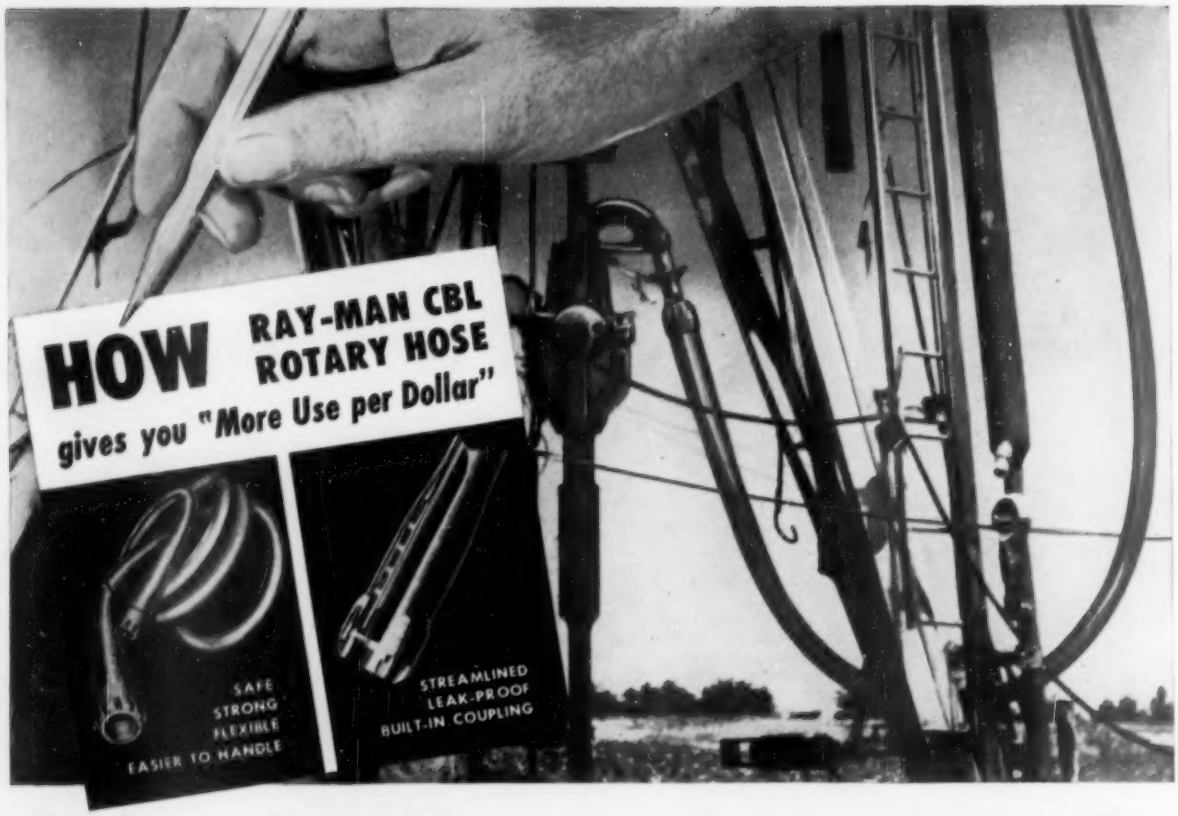


# The Hose that Worry-Proofs your Rotary Rig

The R/M method of applying high tensile steel cable wires under precisioned tension makes Ray-Man CBL Rotary Hose unequalled for strength, flexibility and safety. Because Ray-Man CBL Rotary Hose is flexible without being bulky, it is easier to transport and make up in the rig . . . with unusual freedom from kinking and high resistance to accidental crushing. Also it holds steadier in the derrick without whipping . . . even under the pressures of deep drilling operations. The R/M streamlined, built-in coupling adds to the safety of using Ray-Man CBL Rotary Hose. It is designed without protruding lugs or flanges . . . nothing to cause fouling or damage. The leak-proof, blow-out-proof "Lip-Lok" Seal tightens under pressure. You get the highest safety factor, longest life and lowest cost per foot drilled . . . "More Use per Dollar" . . . with Ray-Man CBL Rotary Hose. Write for Bulletin #6743.

## CONDOR V-BELTS
## R/M SUPER-POWER V-BELTS

Let an R/M representative show you how Condor V-Belts and R/M Super-Power V-Belts are engineered to give you "More Use per Dollar" on deep drilling operations . . . or write for Bulletins #6868 and #6628.

## R/M POLY-V® DRIVES

This new concept of heavy duty power transmission eliminates V-belt matching problems . . . delivers up to 50% more power in the same space as regular V-belts—or equal power in less space! Write for Poly-V* Drive Bulletin #6638.

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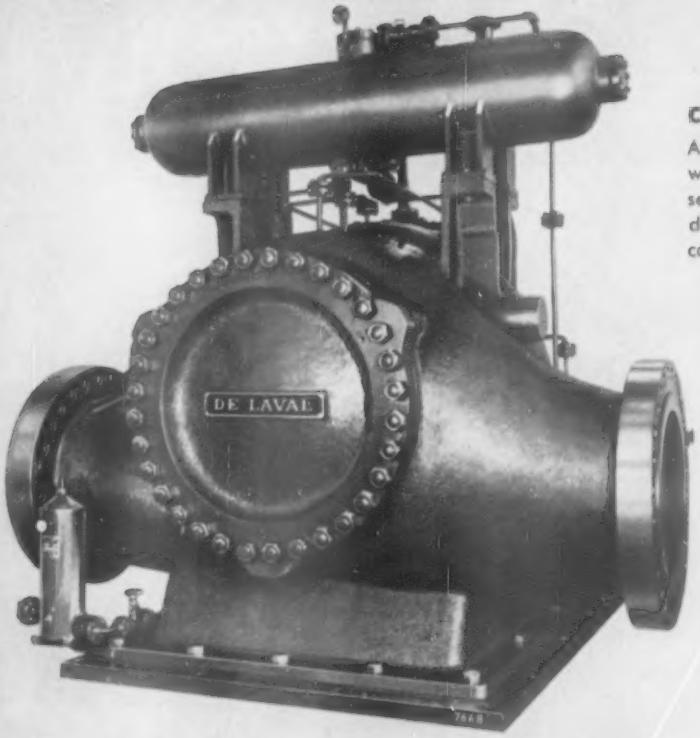
# DE LAVAL
## CENTRIFUGAL PIPELINE COMPRESSORS

# *come in two "packages" for easy installation*

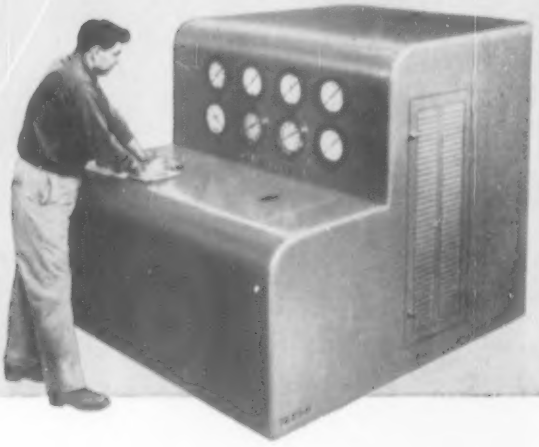



**COMPRESSOR**

A De Laval compressor with its emergency seal tank mounted directly on the compressor.

**CONSOLE**

The console contains the filters, motor-driven pumps, coolers, pressure switches, gauges and other accessories. It eliminates complicated piping on the packaged compressor . . . also serves as a protective cover for the equipment it houses.



Bulletin 503 gives data on De Laval centrifugal pipeline compressors. Write for your copy.

Designed in two packages, rugged De Laval centrifugal compressors offer many important engineering features. Among these are • high pressure contact shaft seal which eliminates gas leakage • heavy and rigid construction throughout • high load carrying capacity. The compressor and console arrangement makes De Laval centrifugal compressors easy to install—only simple low-cost foundations are required. De Laval units, totaling more than 280,000 horsepower, are now in operation on major pipelines.

**DE LAVAL** *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY
*810 Nottingham Way, Trenton 2, New Jersey*

# "Over twice the footage!" says "Red" Royal

"Red" Royal is quoting from a report he got from his friends, Wm. H. Martin, owner, and Oscar Barnes, tool pusher, about U. S. Royal 4 Rotary Hose, 3" x 50'. The footage was rolled up on The Oil Corporation's rig no. 1 near Corpus Christi.

Not only has this hose delivered over twice the footage of ordinary hose, but it also was in service for over 3 years. Another U. S. Royal 4 Hose was ordered to replace it.

U. S. Royal 4 will take the heaviest pressures delivered by today's pumps—plus a comfortable margin for the heavier pumps to come. And you can use U. S. Royal 4 all the way from spud to pay. No need to tie up money on stand-by hose. No lubrication needed. No downtime needed for switching. *Make your next hose U. S. Royal 4.*

**Developed by Science—Proved by Drillers**

***Available in all FIELDS at SUPPLY STORES***

**Mechanical Goods Division**

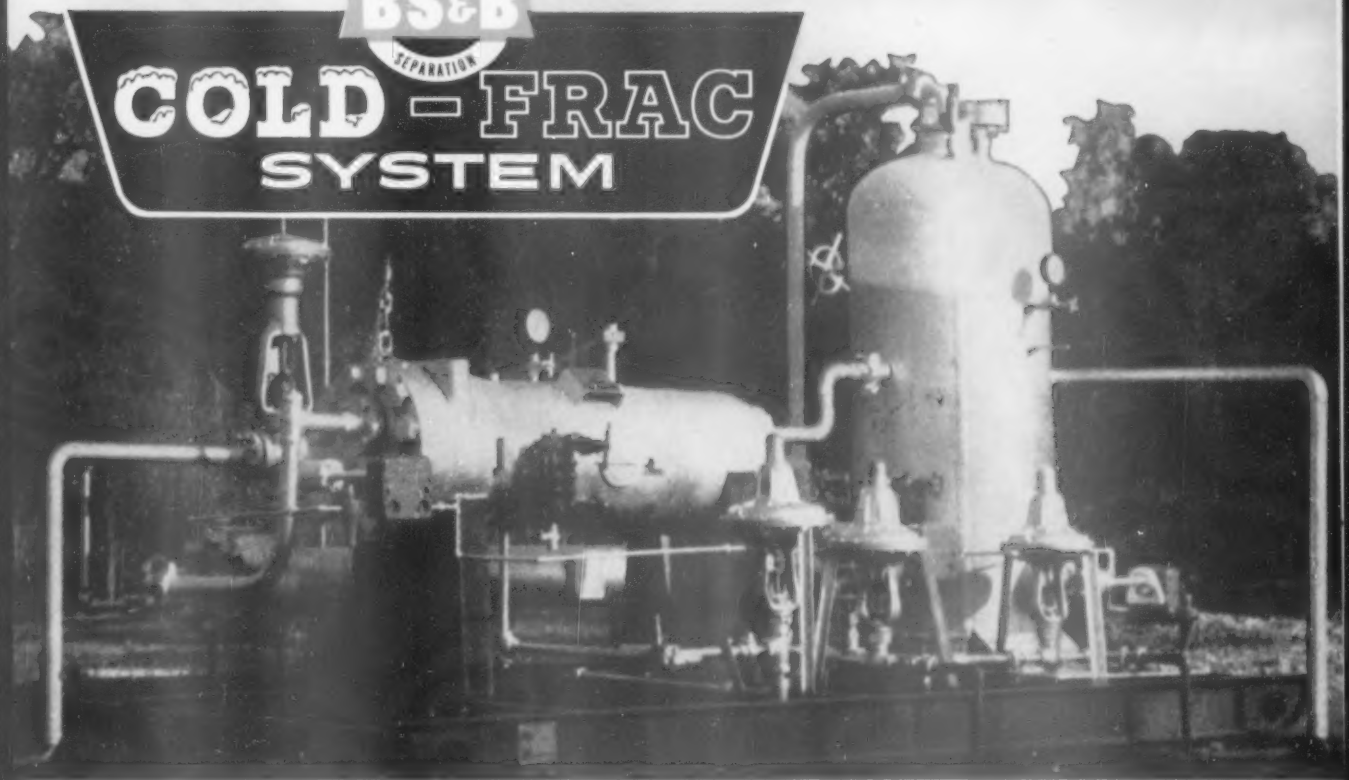
# United States Rubber

# Introducing...

## The New BS&B Model MDH...

LOW TEMPERATURE BS&B SEPARATION

## COLD-FRAC SYSTEM



### Compactly Skid Mounted And Ready For Hook-Up!

The new BS&B Model MDH COLD-FRAC System is a completely packaged unit designed for service on high pressure gas condensate wells. Requiring only four field connections, it is available either with or without a second stage separator. Unsurpassed for economy, performance and freedom from operational troubles. Provides maximum return on your investment!

**FEATURES**

1. Designed For Optimum Recoveries Through Lower Temperatures.
2. Higher Separation Efficiency.
3. Reduced Operating Problems.
4. Less Space Requirements.

Your BS&B Representative Will Gladly Supply You With Detailed Information On The New BS&B Model MDH COLD-FRAC Unit, Or You May Write To...

BS&B — ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.

Oil & Gas Equipment Division, Dept. 1-A5A

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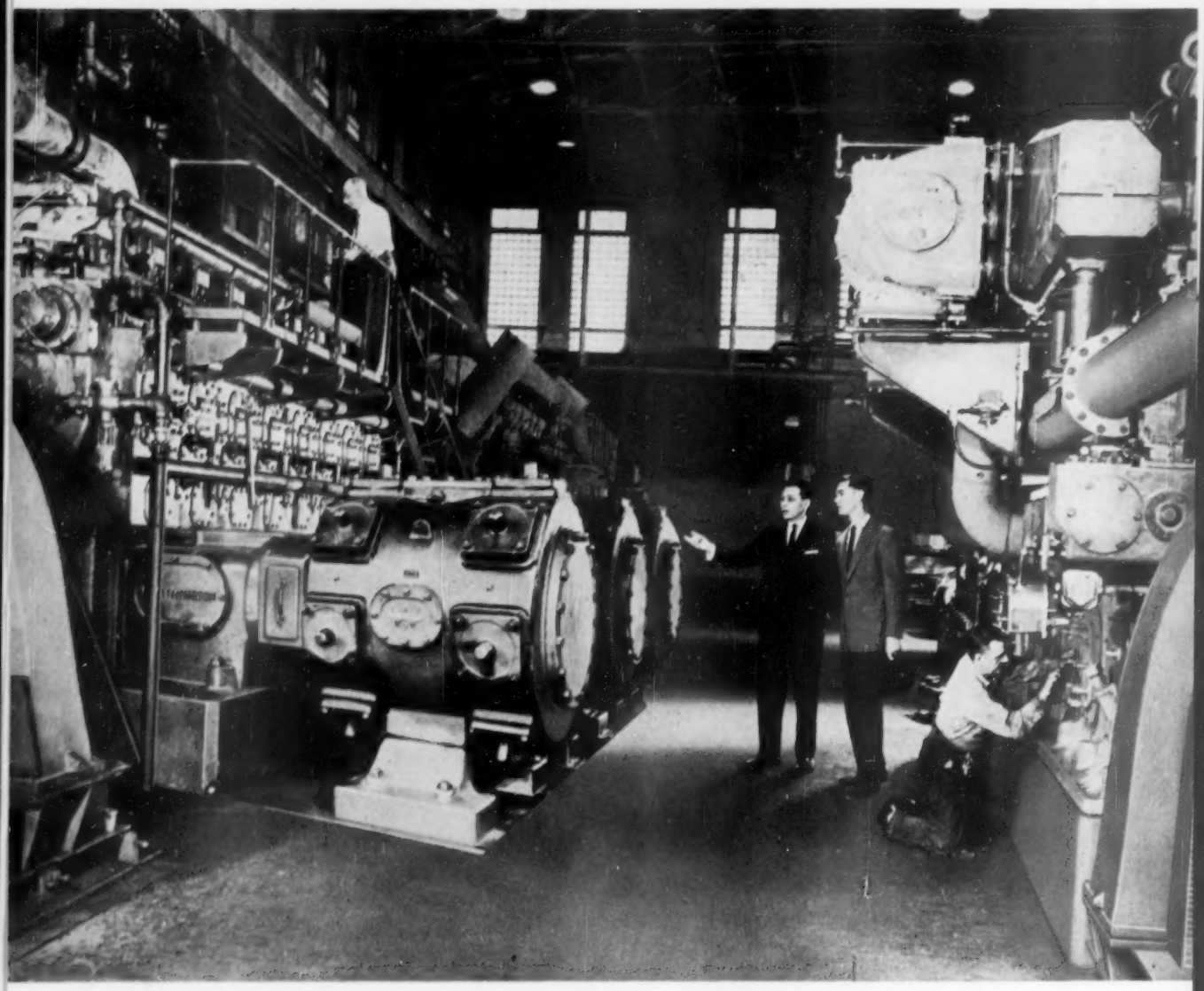
# First 2-cycle pipeline compressor with



## Progressive engineering gives you more for your engine compressor dollar in the TURBO-UNIFLO.

**AFTERCOOLING FOR MAXIMUM LOAD CAPACITY.** Air inlet manifold temperatures must be kept reasonably low to maintain wide engine operational range and overload capacity. This is important in high ambient temperature locations. Low cycle temperatures reduce maintenance on liners, heads, and pistons. Individual aftercoolers mounted immediately adjacent each cylinder inlet give maximum load capacity with accessibility.

**MORE POWER FROM TURBO-UNIFLO DESIGN.** Only cam-operated, timed exhaust valves permit early opening of exhaust to give complete evacuation of burnt gases, and controlled closing for trapping maximum supercharging air. Coupled with pulse-generator ignition, this quiet chain driven timing system gives top performance with minimum maintenance.

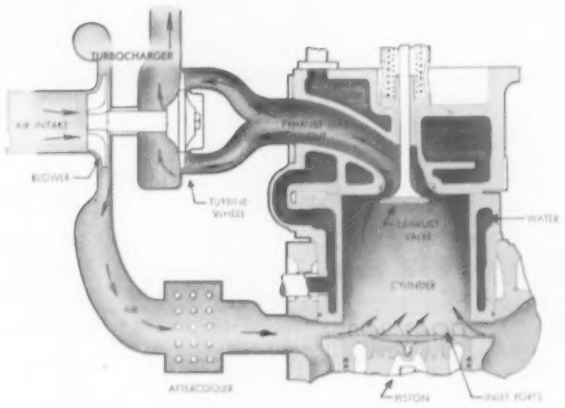
**The only turbocharged 2-cycle engine-compressor with**

# exhaust-powered turbocharging at all loads

## NO POWER-DRAINING EXTRA-DRIVE FOR SUPERCHARGING WITH THE "TURBO-UNIFLO"— WORTHINGTON'S SUTC GAS-ENGINE COMPRESSOR

In its first production year this unique two-cycle turbocharged gas-engine-compressor (750 to 2500 hp) has had remarkable acceptance. Designed for quiet exhaust powered pulse-type turbocharging, on the basis of Worthington's extensive two-cycle engine-compressor experience, more than twenty-four TURBO-UNIFLO SUTC's are either installed or on order. Built to lead the field for years to come, they're industry's best for gas pipeline applications.

By integrating exhaust powered turbocharging with field proven Worthington Uniflo scavenging design, Worthington engineers have developed a two-cycle engine-compressor unequalled for stability of performance over the *complete* range of speed and load requirements. Operating at relatively high compression ratio, the TURBO-UNIFLO has much smoother combustion characteristics than other engines with lower compression ratios. This is due to the basic timing arrangement, engine configuration, and design of exhaust manifolding. Sufficient exhaust gas energy is applied at the turbocharger, from engine start-up through all speeds and loads, to give full turbocharged effect without added external mechanical means for driving the supercharger. Low fuel and lube oil consumptions are other important results of this design arrangement.




**TURBO-UNIFLO OPERATION** — Exhaust valves are timed to open and generate a pressure pulse to move the turbine blades. This gives self-sustained starting and quick acceleration without external aid or mechanical drive. Blower delivers air under pressure to the aftercooler. Cooled air enters the cylinders through inlet ports 360° around the liner. During the scavenging period, the combustion chamber walls and valves are effectively cooled.

The Uniflo system is accepted as having highest scavenging efficiency. It also gives the best turbocharging-scavenge ratio due to complete absence of residual gases in the combustion chamber.

**QUIETER OPERATION.** Cast-iron exhaust manifolding—dry insulated, built-in air-pulse dampener, triple-strand silent camshaft chain, hydraulic valve lifters and elimination of any mechanically-driven air charging device assure quietness.

**FEATHER VALVE.** The feather valve is standard TURBO-UNIFLO equipment. It's the lightest, simplest and quietest valve—and operates with no impact!

For more details on the TURBO-UNIFLO, call your nearest Worthington District Office, or write Section E63, Worthington Corporation, Harrison, New Jersey. E-63

**WORTHINGTON**

**exhaust-powered turbocharging from start-up through full-load**

THIS IS ONE OF FOURTEEN specialized engineering groups at McKee. Modern, well-equipped quarters are completely air-conditioned. Additional facilities for our expanding organization will be provided in a new two-story building now under construction.

# McKee *has the Engineers* to design your plant

● In these days of competition for engineering talent, McKee can supply the services of a large, experienced organization that is well-qualified to design your new plant.

McKee designs and builds blast furnaces, steel plants, petroleum and chemical processing plants, ore preparation facilities and industrial plants. This wide diversification of activities and our fifty-year record of successful, world-wide operation are among the factors which attract top engineers to McKee. Our large staff grows steadily and we continue to welcome applications of qualified men in many fields.

For you, this adds up to an experienced organization capable of undertaking your new plant project promptly and efficiently regardless of size or location.

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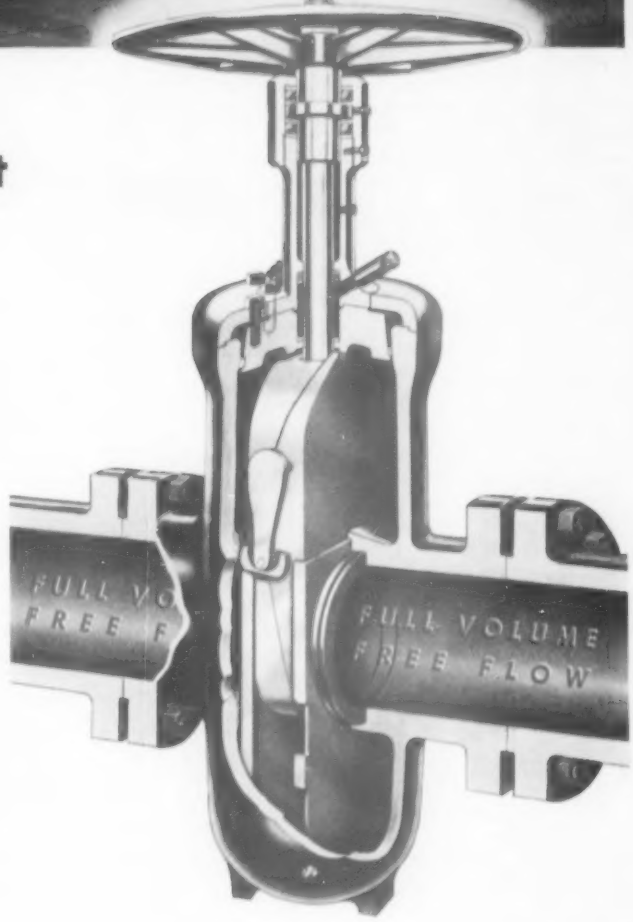
# W-K-M Through-Conduit VALVES

Main lines with W-K-M Valves all the way are the "expressways" of pipeline transportation. The smooth bore through a W-K-M Valve is the same as the I.D. of the pipe and permits the same full volume, free flow as the pipe itself, and allows no more pressure drop or turbulence than an equivalent length of smooth wall pipe. Pump or compressor power is concentrated on transmission — not wasted overcoming obstructions. Scrapers may be run freely through the valves when cleaning the line.

Other advantages of W-K-M Pipeline Valves that contribute to their efficiency in service on the line are Leverlock Control of the parallel expanding gate; pressure seal bonnet that seals tighter as pressure increases; renewable seats; Superfinished stems, ball bearing operation for easier opening and closing under any conditions.

Write or ask your W-K-M Representative for our new pipeline catalog No. 300.

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**W-K-M THROUGH-CONDUIT GATE VALVES**

**acf LUBRICATED PLUG VALVES**

**KEY RETURN BENDS AND FITTINGS**

# Design Factors in Telemetering Systems

## *Four important points to consider in planning for remote measurement or recording*

A BRISTOL APPLICATION NOTE

Telemetering systems provide a proven way to keep tabs on a remotely located process, pipe line, service or utility. In fact, any time remote indication recording, or control is required, telemetering can serve your needs.

Here are the four conditions which must be considered in selecting the best telemetering system for any installation.

### 1. VARIABLES

Most industrial variables can now be measured, computed, and converted into a form that can be transmitted electrically. Their number and variety influence circuit complexity and the appearance of the receiving panel. Some variables now being successfully telemetered include:

**Pressure • Current and voltage • Temperature • Flow • Electrical power • Wind velocity • Liquid level • Motion • BTU's • pH Horsepower • Speed**

### 2. FREQUENCY OF READING

While the majority of telemeter systems in service today are the point-to-point continuous recording type, complex networks and interrelated variables are making sophisticated approaches more and more necessary. The problem usually boils down to these questions: how often is measurement necessary, and what is the least costly way to install and run the system?

Five types of possible hook-ups are:

**Continuous recording**—where variables are critical and need constant watch.

**Intermittent indicating**—where variables need only be checked at intervals.

**Continuous-Intermittent**—where it is possible to separate more critical variables for constant and intermittent telemetering.

**Grouped-Multiplex**—where several measurements can be transmitted as a group over a single circuit into a "multiplexed" receiver.

**Successive-Multiplex**—where measuring points over a large area can be "multiplexed" at intermediate locations, then herded to the panel.

### 3. TERRAIN

The type of interconnecting circuit between the measuring transmitters and central panel usually depends on the terrain: its topography, weather, and degree of settlement. Hence, signals may be carried by one, or by combinations, of the basic transmission media:

**Radio**—various types of radio can be used to take signals over mountains, deserts, and seas.

**Wire**—strung wire or leased lines can cover plant, urban, and rural areas.

### 4. INSTRUMENTATION

Bristol Metameter® Telemeters are eminently adapted to any of the conditions of measurement frequency, variables, or terrain likely to be encountered in telemetering. Transmission can be provided over telephone circuits, carrier current, radio—including microwave, VHF and UHF—and private wires, multiplexing and selective calling. Under all sorts of conditions, thousands of installations, ranging from just a few to hundreds of instruments each, have proven the dependability and reliability of Bristol Telemeters—pulse width (or duration), differential transformer, and voltage types, as well as pneumatic systems.

---

For more information on how Bristol Telemeters can benefit *you*, write THE BRISTOL COMPANY, 120 Bristol Road, Waterbury 20, Conn. 5.44

**TYPICAL RECEIVING CENTER** in multiplexed telemetering system.

**BRISTOL** *POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION*

**AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS**

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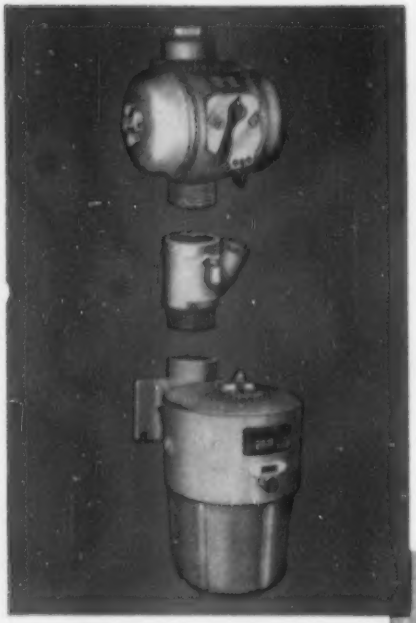

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## Circuit Breaker, Motor Starter and Combination Motor Starter

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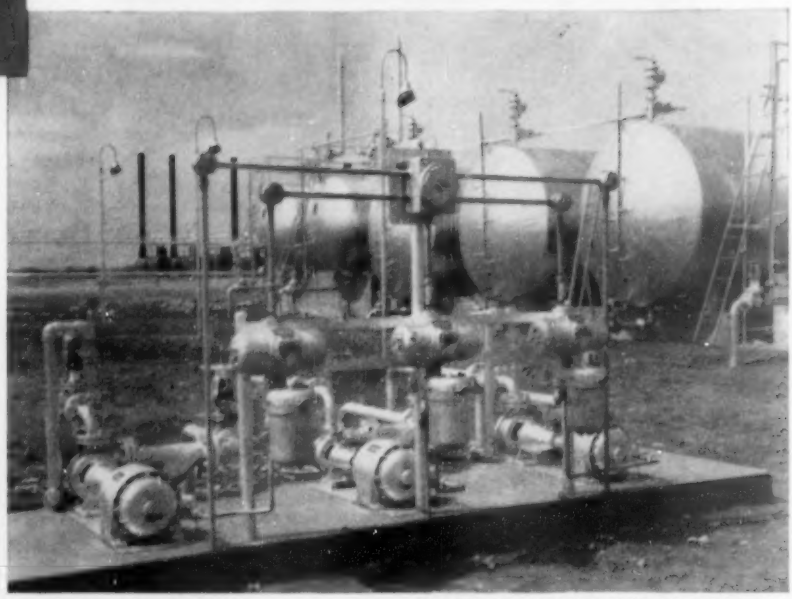

Photo courtesy Oil & Gas Journal

APPLETON Circuit Breaker and Motor Starter Unilets on tank car loading pump motors in field processing plant.

### More TOP-QUALITY features!

- First to be U.L. Approved for banked circuit breaker grouping
- Combinations meet U.L. requirements through approval of components
- No shut-downs while entering motor starter of a combination
- Full 7-thread Explosion-Proof protection
- Unmatched accessibility
- Compact, lightweight construction
- Units may be added quickly, easily
- Flexible field set-ups with single and duplex male and female hub adapters

*Also Manufacturers of:*

***The biggest advancement in Explosion-Proof design in years!*** The design, construction and performance of APPLETON *Circuit Breaker and Motor Starter Unilets* give you maximum safety and unparalleled ease of wiring, installation and maintenance. You'll discover initial and long term savings plus many exclusive APPLETON features, not found in any other enclosure. Where absolute safety is required, regardless of the installation, APPLETON can serve you better! Send for Bulletin BH today for complete information!

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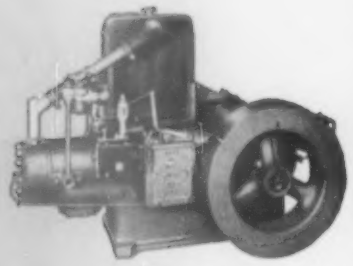
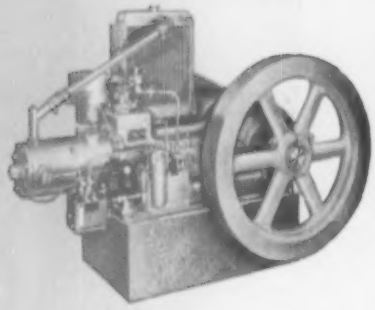
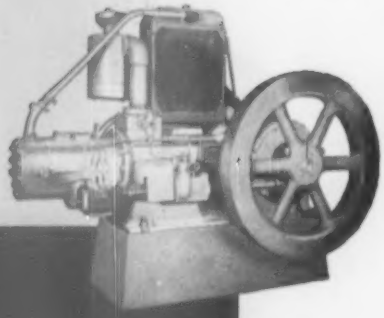
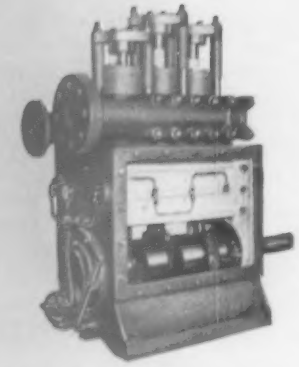






AJAX

## GAS ENGINES
## PRESSURE PUMPS



You get years of service without incident from AJAX Engines and Pumps. Every Ajax part is built for long life in the field under continuous operating conditions. But when you *do* need a replacement item, it's mighty easy to pick up. Just stop at your nearest National, Bethlehem, or R. B. Moore supply store, and you'll find it waiting. • AJAX units are easy to service, too—almost 80 years of experience in building oil country engines makes sure of that. • Make sure *your* next pump or engine is an Ajax: see your Supply Man for the detailed facts!

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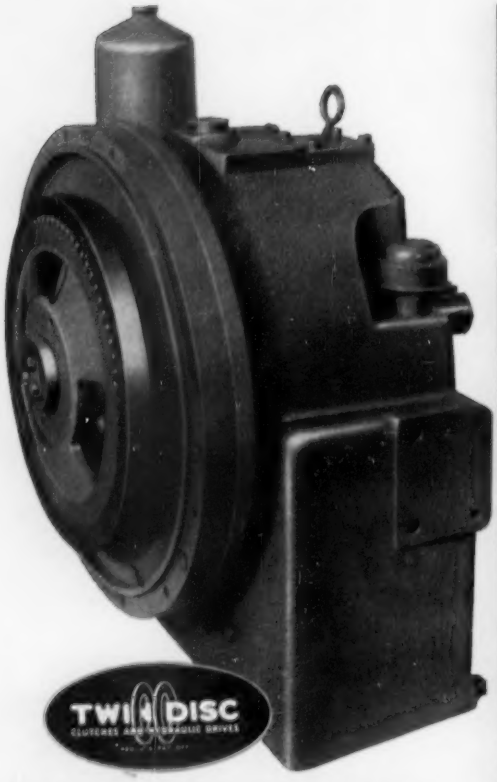


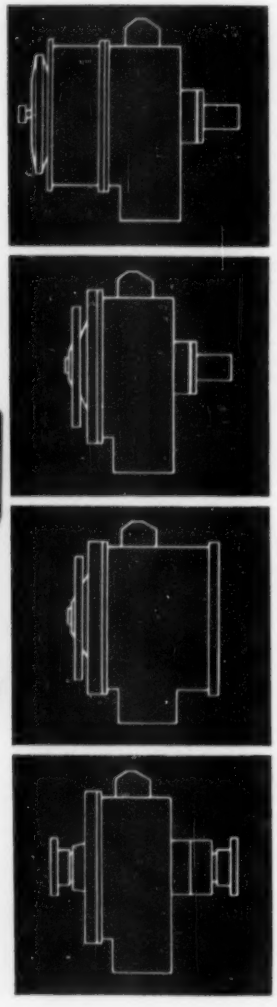

announces new

**SINGLE-STAGE**

**Torque Converters**

Here's another good answer to power transmission problems in the oil fields — the all new Twin Disc *Single-Stage* Torque Converter.

This new single-stage torque converter is currently available in the 1500 Series, which is applicable to engines producing from 30 hp at 1150 rpm to 198 hp at 2400 rpm. Four models provide various input and output combinations.

Already time-proved by extensive field tests, this single-stage torque converter is ideal for truck-mounted rigs and a host of other applications . . . in all types of oil field equipment requiring smooth, efficient, dependable torque multiplication.

This new Twin Disc Torque Converter cuts operating costs . . . boosts profits . . . handles the toughest jobs with ease. The converter's smooth flow of power eliminates sudden load shocks between engine and driven equipment . . . cushions out harmful vibrations.

Specify a Twin Disc Torque Converter in your next piece of powered equipment for oil field application.

TWIN DISC

**TWIN DISC**

**Torque Converters**

TWIN DISC CLUTCH COMPANY, Racine, Wisconsin • HYDRAULIC DIVISION, Rockford, Illinois

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# An ever-

## to solve power

### Torque Converters

The first application on record of fluid drives in the petroleum industry was at Parkersburg, W. Va., on Jan. 23, 1939. A three-stage torque converter — manufactured by the Twin Disc Clutch Company — was used to transmit power from a Cummins diesel engine, to an Oil Well Supply drilling rig.

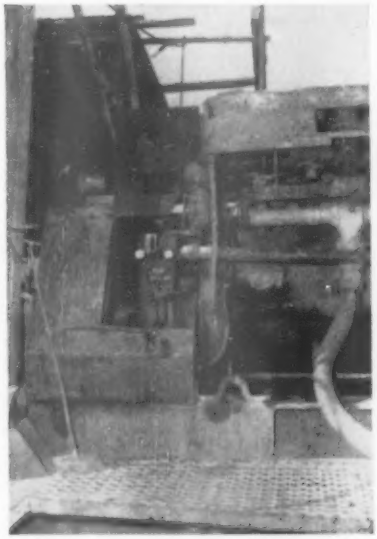
As with most new methods, there were objections raised in changing to an entirely new concept of power transmission. However, outstanding records of performance and dependability, on many of the first installations, soon changed all this. As a typical example, consider the experience of Herndon Drilling Company. In 1940, they used a Twin Disc Torque Converter to transmit power to one of their rotary tables. One million feet of hole, and 325 wells later, the *same* torque converter still performed as effectively as the day it was installed — with the *same* rotary table, and the *same* engine in use. So the torque converter not only proved to be efficient and durable in itself, but also valuable in protecting *both* driving and driven equipment.

The torque converter multiplies engine output torque exactly as needed (the Twin Disc Three-Stage up to six times at stall, if required) — consequently, harmful, costly engine lugging and stalling are eliminated. Overloads, shock loads and vibrations are cushioned *out*—through *fluid* connection and power is *automatically* matched to the load demand.

News of these heretofore unheard of advantages quickly spread to other oil fields and in just a few years, torque converters were found in every major field — on all types of engines and drilling rigs.

# increasing trend to fluid drives

## transmission problems in the Petroleum Industry



Work-scarred, but still performing efficiently after 1,000,000 feet of hole, this Twin Disc Torque Converter owned by Herndon Drilling Co., has long proved its ability to speed footage and protect equipment.

It was quickly discovered, for example, that fluid drives were also advantageous on mud pumps. Obviously, with the advent of the internal combustion engine, the power factor of mud pumps was seriously impaired, since it was no longer possible to achieve the broad pressure-speed ratios that the steam pump offered. But introduction of the torque converter to mud pumps brought back all the flexible characteristics of steam, allowing higher volumes of fluid during the low pressure part of the hole, resulting in less frequent liner changes.

### Fluid Couplings

Along with the rapid acceptance and the increasing demand for torque converter drives in the petroleum industry, a wide choice in other fluid drives became available through use of the fluid coupling. This fluid drive provides all the shock-cushioning features of the torque converter, but is for applications *not* requiring torque multiplication.

One of the most common fluid couplings used in the oil fields is the disconnecting fluid power take-off, or dumping coupling—making its debut in the oil fields about 1950. One of its first applications came when a Twin Disc Model HUD Disconnecting Fluid Power Take-Off was used by the O'Neal Drilling Company of Lubbock, Texas, to transmit power from a Waukesha engine, to an Emsco GA-500 drilling rig.

The Twin Disc Model HUD has all the advantages of other fluid drives —except that, unlike the torque converter, it does not multiply torque. It does, however, have the ability to "dump" its oil, which affords a complete disconnect between the engine and the drilling rig. Thus the Model HUD eliminates the need for a space-consuming cut-off clutch.

Although the disconnecting fluid power take-off is one of the most widely used fluid couplings in the oil fields today, there are many smaller fluid couplings being widely used on different types of equipment. For example, on many pumping jacks, Twin Disc HYDRO-SHEAVE® drives are found — cushioning heavy starting loads, to relieve motor or engine damage and excessive belt wear, and to reduce peak polish rod loads.

Twin Disc Disconnecting Fluid Power Take-Offs —used in one of the first applications of this type fluid coupling—transmit power from three Waukesha Engines to an Emsco Rig, for O'Neal Drilling Company.

### A Complete Line

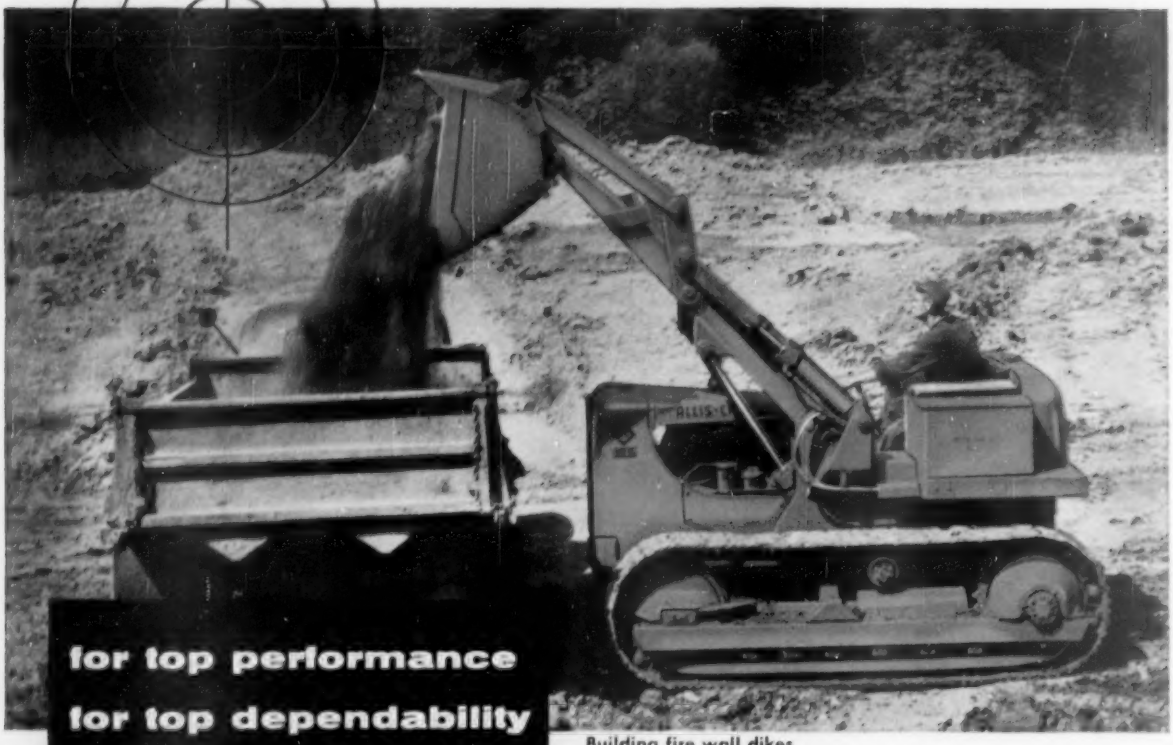
First to introduce the torque converter to this country, Twin Disc has maintained its leadership in the industry through the ensuing years. Therefore it's not surprising that the latest announcement of interest to drilling contractors comes from Twin Disc. It is a new line of *single-stage* torque converters. Currently available are the 1500 Series models for engines producing from 30 to 198 hp. Development of additional sizes of single-stage torque converters is in progress, and their availability will be announced shortly.

In addition to the most complete line of *fluid* drives available, Twin Disc also offers a complete line of friction clutches — and recommends these drives without bias when they are best suited to a particular piece of equipment on a particular job. For example, Twin Disc Air Clutches can be found on drawworks, rotary tables, and hoisting drums — while rugged Twin Disc Friction Power Take-Offs dependably transmit power to virtually any kind of equipment, used throughout the oil fields.

Yes, world wide, from Texas to Arabia, from Oklahoma to Venezuela, *anywhere* you find *oil* . . . you find Twin Disc Fluid and Friction Drives at work, solving the *tough* problems involved in *proper* power transmission.

*(Advertisement)*

# Set your sights on an HD-6G



**for top performance**
**for top dependability**
**for top versatility**

**1½ yd bucket** **55 belt hp** **19,600 lb**

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**One-piece steering clutch and final drive housing** — line-bored for true alignment of shafts and gears.

**Straddle-mounted final drives** — with bearings on both sides of gears to maintain correct gear tooth alignment.

**Simplified lubrication** (including 1,000-hour lubrication intervals on truck wheels, idlers and support rollers) provides extra working time.

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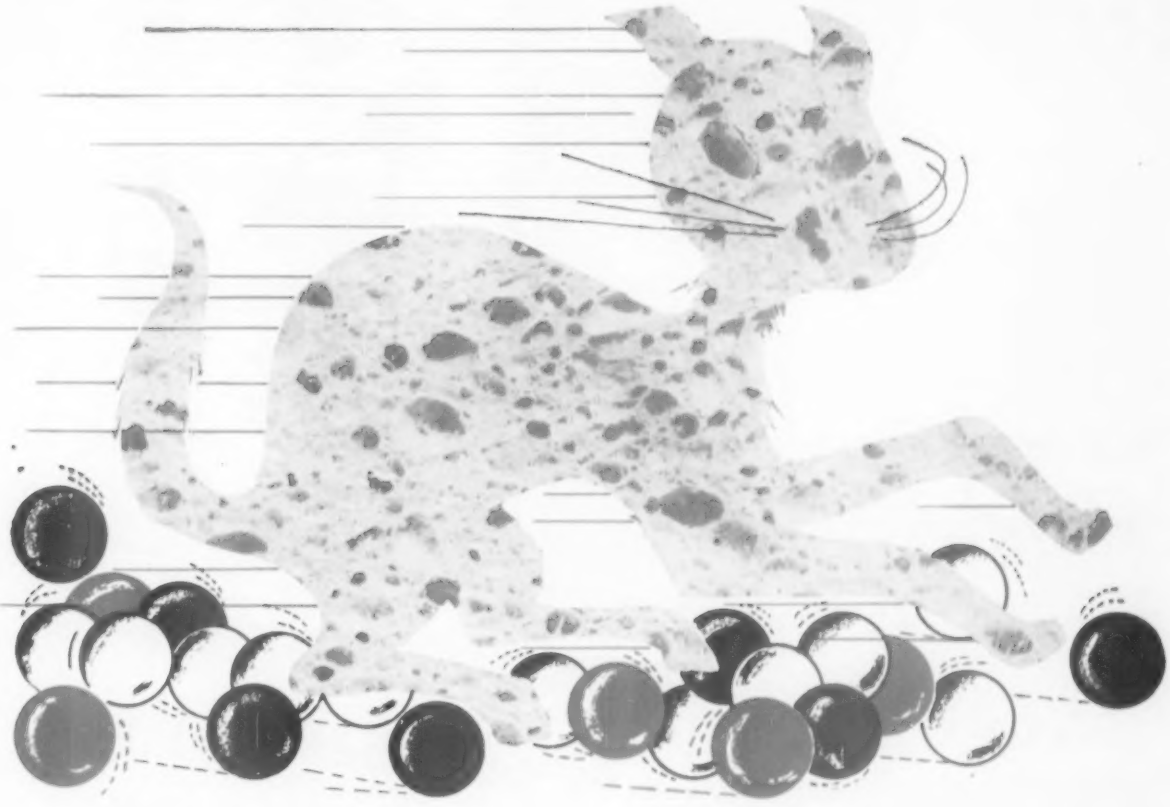

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**Spring-Loaded Plunger** packing is self-adjusting, self-sealing, eliminates the human element.

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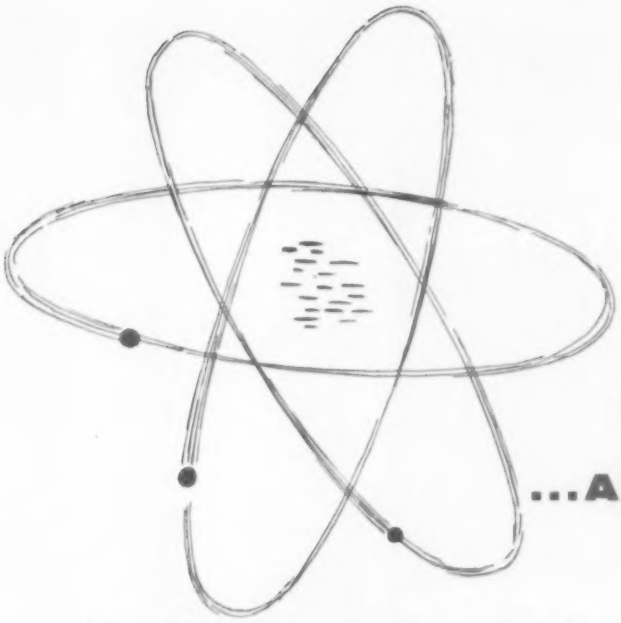

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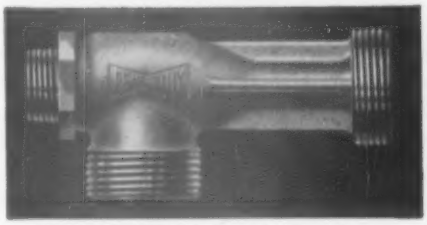
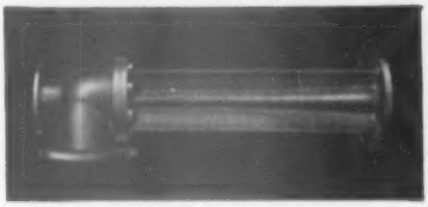


Series 60A fluid operated jet pump for lifting, elevating and blending liquids or slurries.



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Special stainless steel where corrosion resistance and/or non-contamination are required.

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Recently, at the East Chicago, Indiana plant of the Sinclair Refining Company, a second B&W CO Boiler* was placed on stream. Sinclair, the originator of the CO Boiler as applied to Fluid Catalytic Cracking Units, made the first installation at its Houston, Texas refinery. As a result of the savings in fuel, Sinclair, in an advertisement, called it the "Thriftiest Boiler in the Business."

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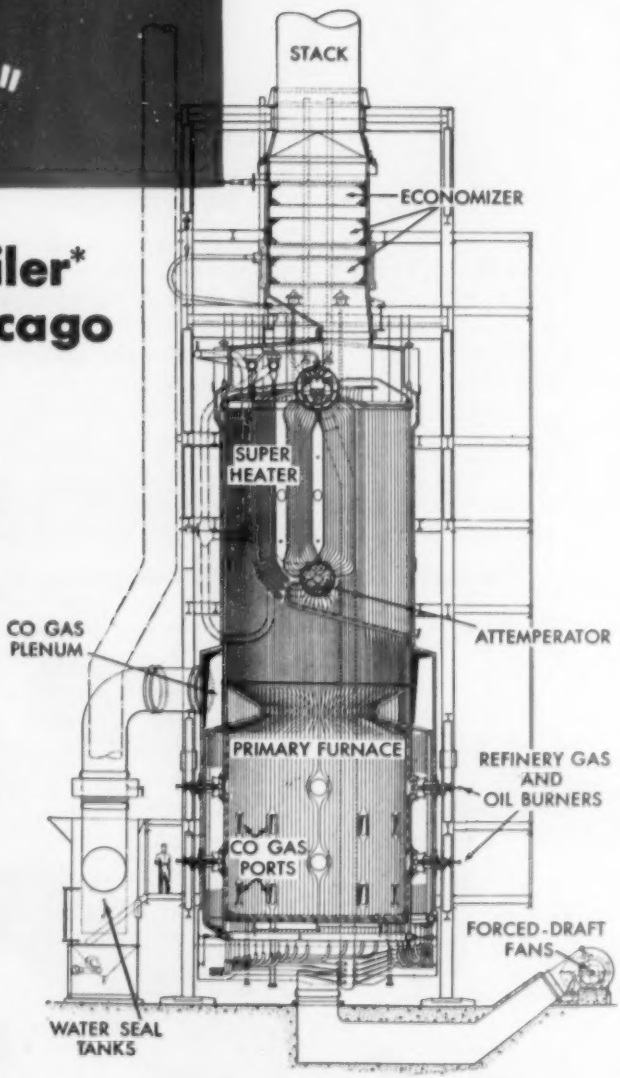
We will be glad to furnish you with full details of the B&W CO Boiler and what it is doing for others, and can do for you. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

*Carbon Monoxide Boiler

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BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES

FIG. 3059 (Sectional)
A.S.A. 300-pound Steel
Lubricated Plug Valve

FIG. 1559G—
150-pound Steel
Lubricated Plug
Valve. Gear operated

FIG. 2200—175-pound W.O.G.
Semi-Steel Lubricated Plug Valve

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Standard two-piece sealing ring made of Cook Graphitic Iron. Advantages include single-ring groove contact and dual-ring cylinder seal. Proven remedy for blow-by.

WHATEVER your piston-ring requirements — Plain, Full Sealing, Segmented or Oil Wiper — there's a "job-engineered" Cook Ring to fill the bill.

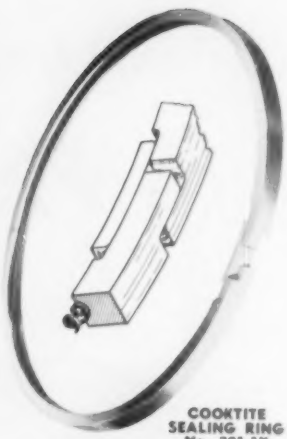
Chief among the advantages of Cook Piston Rings is Cook Graphitic Iron. An exclusive material that's made in our own foundry, Cook Graphitic Iron possesses excess carbon in the form of graphite flakes. This greasy substance eases the ring over dry spots, and helps form a hard, mirror-like surface which minimizes friction and assures *longer cylinder life, better engine performance.*

Our nation-wide Engineering Field Staff stands ready to serve you — in Baltimore, Chicago, Cleveland, Denver, Houston, Jacksonville, Joplin (Mo.), Los Angeles, New York, Tulsa and Philadelphia. Or write direct to Louisville for literature and recommendations.

**C. LEE COOK COMPANY**

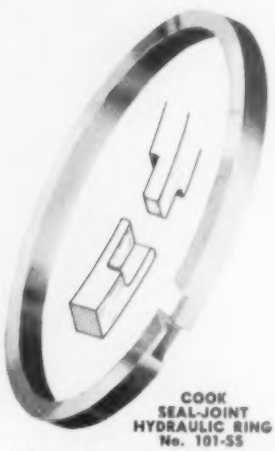
*Sealing Pressures Since 1888*

**966 South Eighth Street**
**Louisville, Kentucky**



**COOKTITE SEALING RING No. 301-1X**

New, two-piece sealing ring made of Cook Graphitic Iron or Cookmet Bronze. Complete flexibility assures perfect wall contact at all times. No wearing period required.

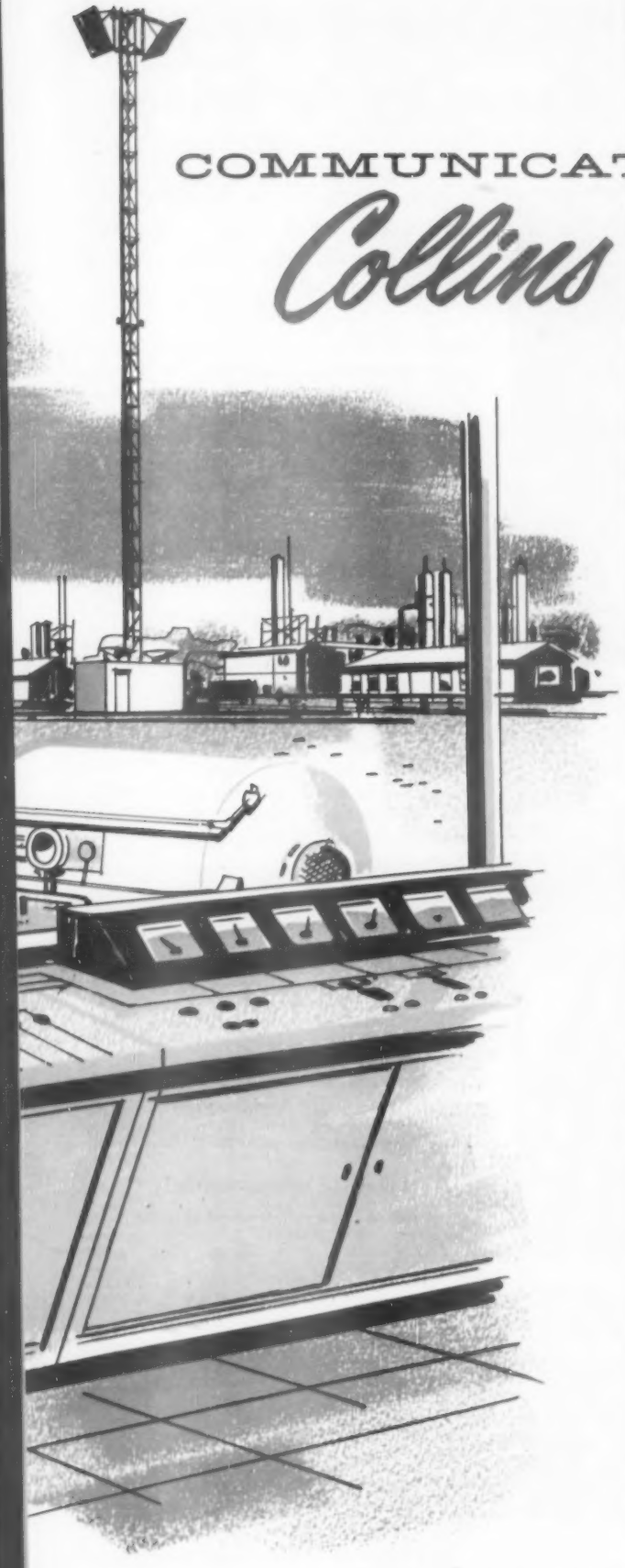


**COOK SEAL-JOINT HYDRAULIC RING No. 101-SS**

Unique, single acting sealing ring for use in all grooves. Seal-joint construction provides unbroken sealing surfaces against both cylinder wall and groove land.

**COOK SUPER-FLEX WIPER RING No. 303-DCX**

One-piece conformable oil wiper ring made of Cook Graphitic Iron. Life-time coil spring provides uniform contact pressure. Wide channel and multiple notches assure direct flow to drain holes.



# COMMUNICATION, CONTROL

# *Collins* MICROWAVE

Incorporating Collins Mechanically-Filtered single sideband multiplex, Collins High Density Microwave provides 120 channels, highly reliable performance and simplified maintenance. Channels may be used for supervisory control, system telemetering, remote VHF station operation, automatic load control, centralized office accounting, facsimile and Teletype as well as private voice circuits.

- **120 CHANNEL CAPACITY** provides for future expansion without obsolescence.
- **MECHANICALLY FILTERED SSB MULTIPLEX** permits high channel loading of RF system.
- **RELIABLE TUBES** include long-life reflex klystron and ARINC-approved types.
- **OPTIONAL BATTERY OPERATION** utilizes chargers and storage batteries to provide an uninterrupted power supply.
- **FREQUENCY DIVISION MULTIPLEX** provides flexible channeling without complicated or critical circuitry.

Collins engineering services are available for evaluating, planning, and installing your integrated communication system.

*Collins*

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**COLLINS RADIO COMPANY**

Dallas • Cedar Rapids • Burbank • New York • Washington, D.C.

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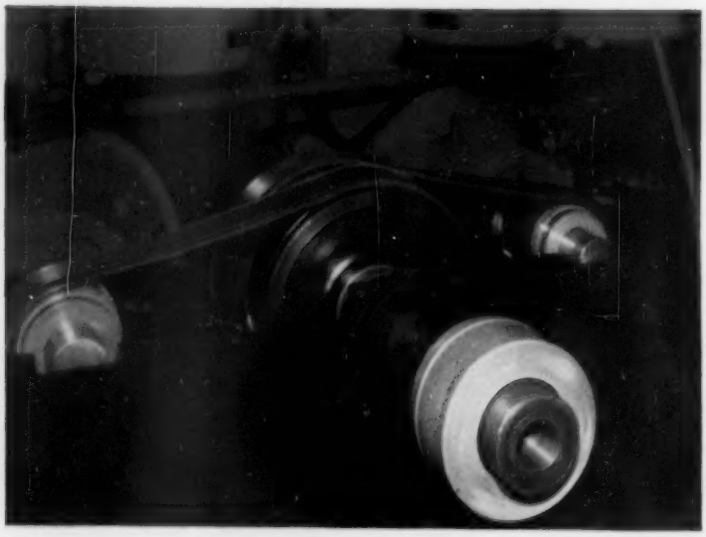
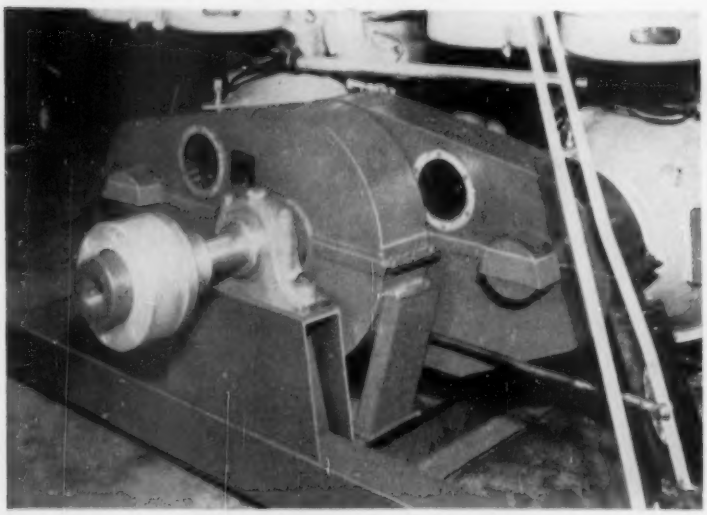
# Get Maximum HP Output from High-Speed Diesel Engines with Morse Hy-Vo Drives



Note the smooth action of Morse HY-VO in operation. Matched 182-HP diesel engines, operating at 1450 RPM, are twinned through HY-VO Drives to jack shaft, which operates at 650 RPM. Jack shaft delivers 364 HP to load shaft (not shown), to which it is coupled with Morse Morflex Radial Coupling (see below).



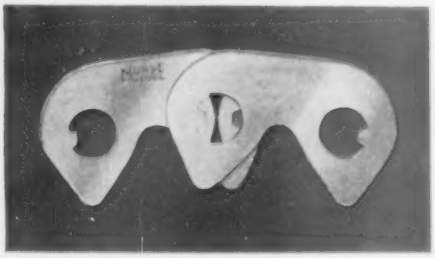
Twin HY-VO Drives are encased in sealed casings, permit continuous forced-spray and sump oil lubrication. Observation ports permit inspection. Morflex Radial Coupling cushions any shock loads from driven unit, prevents engine pulsations from entering driven shaft.

**Southern Bearings Service and Lewis-Diesel Engine Company solved difficult drive problem at low cost to customer.**

Morse Hy-Vo Drives helped solve a typical power-transmission problem for Lewis-Diesel Engine Company (Memphis, Tennessee). Working with Southern Bearings Service, Inc., the local Morse distributor, they combined twin high-speed diesels with two Morse Hy-Vo drives to get low-cost, low-speed, high-horsepower output.

By compounding two small, high-speed diesel engines with required reduction ratios, the need for a big, expensive, low-speed engine was eliminated. Quick access to individual drive units was made possible without disturbing main compound base. Customer downtime is reduced to a minimum.

Compact Morse Hy-Vo Drives provide smooth, positive power transmission at speeds up to 8,500 fpm. They combine the positive action of gears with the favorable load distribution of chain; are rated at 20,000 hours' service life.



HY-VO Drive links, showing exclusive rocker-type joint. Rocker joint reduces wear and friction, results in coolest running chain drive.

**Complete information free**

For complete information and engineering assistance on Morse HY-VO Drives, contact your nearest Morse distributor. Write, wire, or call him today.

MORSE CHAIN COMPANY
INDUSTRIAL SALES DIVISION
ITHACA, N.Y.

**MORSE**

MORSE BW *trademark

See distributor listings on page at right

**POWER TRANSMISSION PRODUCTS**

**MORSE**

CHAIN COMPANY

BW

**REPRESENTATIVES**

**CALIFORNIA**
Adam-Hill Company
7501 San Leandro Street
Oakland, California

Adam-Hill Company
244-246 Ninth Street
San Francisco, California

I. W. Minder Chain & Gear Co.
6011 S. Central Avenue
Los Angeles 1, California

**OREGON**
J.W. Minder Chain & Gear Co.
311 S. E. Hawthorne Blvd.
Portland 9, Oregon

Power Transmission Prod.
1107 N. W. 14th Avenue
Portland 9, Oregon

**WASHINGTON**
Chain Gear, Inc.
822 First Avenue, S.
Seattle 4, Washington

**CANADA**
Western Equipment Co. Ltd.
102 Main Street
Vancouver, B.C.

Western Equipment Co. Ltd.
2003 Government Street
Victoria, B.C.

**DISTRIBUTORS**

**ARIZONA**
Semon Bearing Company
325 N. Third Avenue
Phoenix, Arizona

**CALIFORNIA**
**Anaheim**
P & L Transmission, Inc.
517 E. La Palma

**Arcata**
Munnell & Sherrill of Calif.
1041 F Street, P.O. Box 217

**Colton**
Valley Industrial Supply
401 S. 8th St.

**El Centro**
W. H. Douthitt
Route 1, Box 183

**Fresno 06**
Gordon Equipment Co.
Box 3100
2309 Los Angeles St.

**Marysville**
Bearing Belt Chain Co.

**Ontario**
Valley Industrial Supply
1170 W. "A" Street

**Redding**
Cascade Indust. Supply Co.
Highway 99, So.

**San Diego**
Standard Iron Works
Harbor Drive & Beardsley

**San Jose**
Orchard Supply Company
720 W. San Carlos

**Stockton**
The Bearing Supply Co.
300 N. Wilson Way

**Yreka**
Siskiyou Tractor & Equipment Co.

**COLORADO**
**Denver**
Union Bearing & Trans. Co.
1622 Wazee Street

**MONTANA**
**Great Falls**
Strong-Scott Mfg. Co.
427 Second Street, So.

**Kalispell**
Industrial Supply Co.
175 N. E. Railroad St.

**NEVADA**
**Las Vegas**
Las Vegas Machine & Eng. Co.
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**OREGON**
**Astoria**
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**Bend**
Bend Specialized Service
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**Eugene**
Electric Steel Foundry Co.
1464 W. 6th Street

**Grants Pass**
Cascade Indust. Supply Co.

**Klamath Falls**
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**McMinnville**
Auto Electric Company
1114 W. Baker Street

**Medford**
Rogue Equipment Sales
2920 No. 99

**North Bend**
Industrial Steel & Supply Co.
P.O. Box 824

**Portland**
Electric Steel Foundry Co.
2141 N. W. 25th Avenue

**Salem**
Mill Supply Corporation
465 South Church Street

**UTAH**
**Salt Lake City 12**
Bearing Eng. & Sales Co.
P.O. Box 1885,
756 S. Second St. W.

**WASHINGTON**
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Grays Harbor Equip. Co.
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**Bellingham**
Schuman Steel Products Co.
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**Spokane**
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Reel Machinery Company
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**Yakima**
Central Chain & Transm.
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**WYOMING**
**Casper**
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**WESTERN CANADA**
**Calgary, Alberta**
Electrical Industries, Ltd.
325 10th Avenue, W.

**Edmonton, Alberta**
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324 Vernon Street

**Vancouver, B.C.**
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**Vernon, B.C.**
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**Saskatoon, Saskatchewan**
Bearing-Transm. Supply
335 Avenue B South

**EXPORT SALES**

Borg-Warner International Corp.
33 S. Wabash Ave
Chicago 3, Ill.


# They Say—

### Oil Price Hike Remote

"In the long run a rise in the price of crude is inevitable . . . finding and developing new crude-oil reserves is a high risk venture that can attract sufficient capital only if there is a return commensurate with the risks involved . . . costs have risen since the last general crude oil price increase in 1953 as the industry has extended its search to deeper horizons and to more remote areas . . .

"But, except in the long run, costs do not determine prices . . . the forces of supply and demand determine what prices shall be this month and next . . . These forces do not . . . warrant an increase in crude-oil price today . . . domestic sources to which we look for nearly 90 per cent of our country's crude-oil needs are in ready if not easy supply over a major portion of the United States.

". . . Consumers do not buy crude oil but rather products derived from crude . . . It is only in recent months that average prices of petroleum products have permitted realizations high enough to offset the current crude-oil price and permit a reasonable return on investment, in the refining and distribution branches of the industry . . .

"Further growth in demand will shrink supplies and call for new investment which may well require increased product prices as the inducement to provide such investment . . . When product prices move toward these higher levels, I have no doubt they will be reflected in the price of crude oil without which such products cannot be produced."

*C. T. Foster, president of Standard Oil Co. (Ohio) in meeting of company stockholders, Cleveland.*

### TIPRO's Platform for Gas

"Membership of the Texas Independent Producers and Royalty Owners Association . . . authorize the Executive Committee on behalf of the association to give full support to . . . state legislation . . . to eliminate gas pipeline company discrimination in quantities taken and prices paid as between producers in a field and fields in the state, such measures to include any or all of the following:

". . . **Statewide "market demand"** bill.

". . . **Ratable taking bill,** with provisions adequate to induce pipeline companies to bargain in good faith for


Strahman

HIGH PRESSURE GAUGES

*USED IN* **REFINERIES** *AND* **CHEMICAL PLANTS** *THROUGHOUT THE WORLD*

**THRU VISION**

**REFLEX**

*Single or Multiple Sections*

**TUBULAR**

**Gauge Cocks**
•
**Large Chamber Reflex Gauges**
•
**Heated or Cooled Gauges**

*SEND FOR* **COMPLETE CATALOGUE**

**STRAHMAN VALVES, Inc.**
**16 Hudson St., New York 13, U.S.A.**

BRANCH
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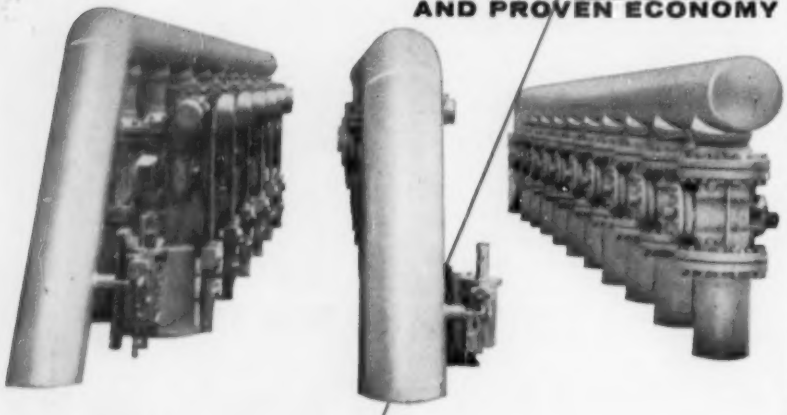
WELDOLETS

FOR ASSURED STRENGTH
AND PROVEN ECONOMY



WELDOLETS

THREDOLETS

SOCKOLETS

Are you effecting this economy for your company? Neat and uniform appearance is evident in code constructed weldolet headers in this crude oil pipeline terminal. The money saved is in the bank and does not appear in this picture. If you are not using the weldolet method of cutting piping costs, write today for information.

BONNEY

*SOLD THROUGH LEADING DISTRIBUTORS*

WELDING FITTINGS DIVISION
BONNEY FORGE & TOOL WORKS
366 GREEN ST., ALLENTOWN, PA.

all Texas gas in all fields in order to fill market demand.

"... **Bill to prohibit discrimination** by gas purchasers in the purchase of gas.

"... **Common carrier bill** to require pipeline companies to transport gas at prescribed tariffs on basis similar to oil."

*Resolution approved by annual meeting of TIPRO, Dallas.*

**Gas Controls Harmful**

"We felt the long range interest of our company, our customers, and our stockholder would be best served if gas producers were permitted to operate in a free and competitive market . . .

"While there has been only a short period of experience with the regulation of producers, this short experience has convinced us that this type of regulation will be complicated and cumbersome and can only result in confusion and delay which will be harmful to all concerned."

*Stuart M. Crocker, chairman of the board, Columbia Gas System, Inc., in remarks at stockholders meeting, Wilmington, Del.*

**U. S. Steel Dilemma**

"There are only two possible solutions to this problem (raising funds for expansion) which stems from past inflation and the possibility of continued inflation.

"The best and most logical solution could be achieved through prompt and realistic revision of the depreciation laws. But that can only be done by Government, for the root of the difficulty lies in the inadequacy of normal depreciation provisions of the law. The time has come, I think, when Congress should face up squarely to the fact that these depreciation provisions no longer serve the purpose for which they were intended. It is time to reappraise the law and to revise it realistically.

"The only other possible solution is to increase the profit margin substantially.

"The first of two ways in which this can be accomplished is by increased efficiency of operations and consequent cost reduction . . . but there are rigid limits on the rapidity with which economics can be effectuated and on the total savings possible. The sole remaining method is by raising prices from time to time . . . In the absence of a more realistic treatment of depreciation, there is simply no other course . . .

"U. S. Steel recognizes a definite responsibility to keep annual wage changes within bounds but it also has the responsibility to meet to the best of our ability, the proper needs and aspirations of our employes. And to

GUIBERSON TUBING SWAB

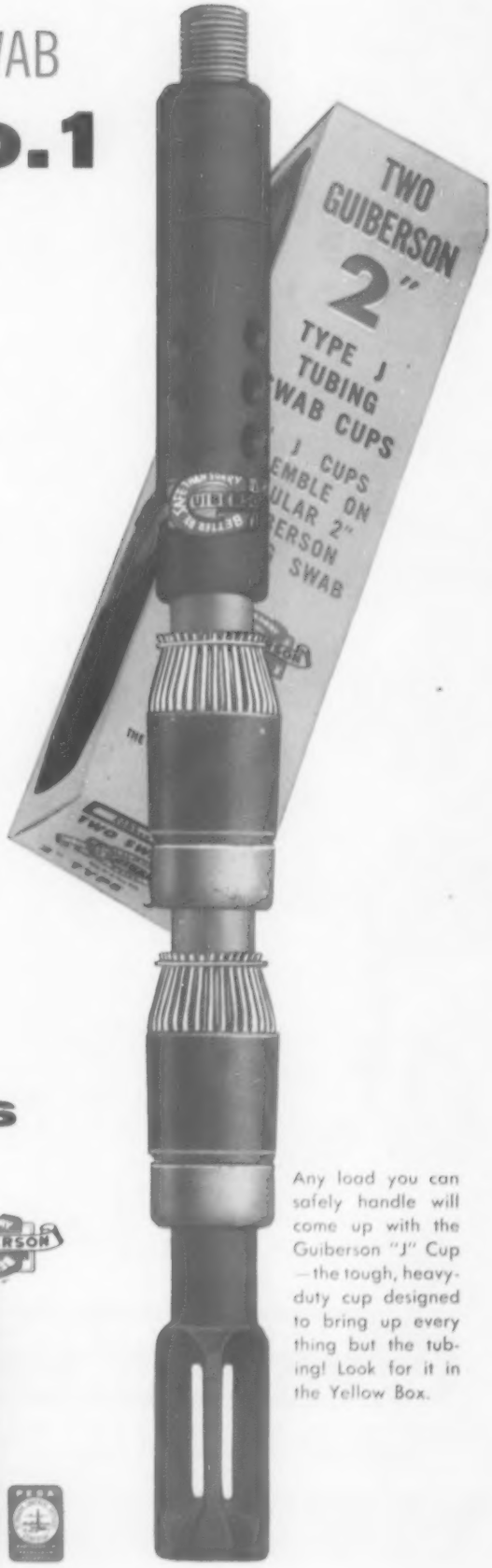
# world's no.1 swab

Because it

**gives you more efficiency and reliability – more for your money**

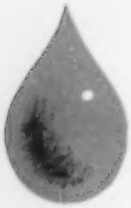
Because

**we manufacture our swab cups in our own rubber plant – from our own carefully compounded synthetic rubber formulas**

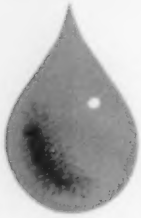



Any load you can safely handle will come up with the Guiberson "J" Cup — the tough, heavy-duty cup designed to bring up every thing but the tubing! Look for it in the Yellow Box.

THE
GUIBERSON
CORPORATION
ESTABLISHED 1919 • DALLAS, TEXAS, U. S. A.
Sold By Leading Oil Field Supply Stores Everywhere



**BEHIND MILLIONS OF BARRELS OF PRODUCTION**



## Financing by the Republic

The nation's oil reserves are millions of barrels richer because of production loans made by the Republic. With a record of service to oil men equaled by few other banks in the nation, Republic's Oil Department is constantly seeking new opportunities to serve the petroleum industry.

WHAT CAN WE DO FOR YOU?

**REPUBLIC National BANK of Dallas**

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

CAPITAL AND SURPLUS $70,000,000 • LARGEST IN THE SOUTH

the nation as a whole we have a further responsibility to avoid, if possible, a strike that would choke off the supply of steel and bring serious financial hardships to workers and owners in hundreds of plants that depend on that supply of steel."

*Roger M. Blough, chairman of U. S. Steel Corp., in statement to stockholders meeting, Hoboken, N. J.*

**Quick Transfer**

Dear Sir:

Dave Stormont (Los Angeles district editor) knows better, so I guess we can safely blame the printer for this one. He must have dropped a line from the first column story on page 90 of your April 23 "Unitization Vote Set" because James T. Wood, Jr., is vice president of The Texas Co. at Los Angeles, and NOT vice president of Continental Oil Co.

Somehow, could you please restore Mr. Wood's long-standing (27 years) Texaco affiliation, and also put The Texas Co. on record as strong supporters of the proposed California Oil and Gas Conservation Act?

Incidentally, the piece . . . on the R. W. Ragland-A. C. Rubel "debate" (April 16, page 122) was an excellent job of dispassionate, objective reporting.

Robert T. Kenney
Assistant Director,
Public Relations
The Texas Co.
Los Angeles.

*Editor's note: A line was dropped, but not by a printer. It was missed by one of our Tulsa staff in copying the list of signers of the nominating petitions. The line should have read: "James T. Wood, Jr., vice president of The Texas Co.; Olen Lane, vice president of Continental Oil Co." etc.*

**It's Not Easy**

Dear Sir:

Thank you very much for reporting on page 95 of the April 30 edition of The Oil and Gas Journal, the paper which I gave at the Eastern A.P.I. Production Division meeting at Columbus, Ohio, on April 26.

I would, however, like to correct some errors in your report. The title which you assigned "Finding Reefs Is Easy" is very much in error, as are the statements that gravity surveys can readily locate Niagaran reefs or that these reefs can readily be mapped with gravity surveys.

The gravity meter has proved its value as a tool for locating the Niagaran reefs, but in many areas the anomalies are quite obscure and a number of other subsurface conditions can produce anomalies identical with those pro-


In Pipeline Service...

MAKE SURE YOUR SMALL PIPING IS JOINED SAFELY, TOO

W-S

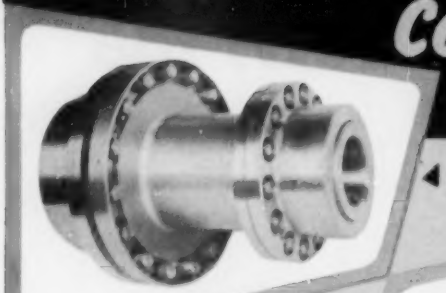
■ W-S Forged Steel Fittings provide safe, tight connections for your small diameter, high pressure piping. In gathering lines . . . pump and compressor piping . . . instrument lines and other high pressure lines, 4" and under in diameter, W-S fittings protect you against costly down-time. They're drop-forged for extra strength and toughness—and they're safety-factor designed.

Watson-Stillman Fittings are available in screw-end and socket-welding types in carbon steel, stainless steels and alloy steels. Send for your copies of our informative catalogs.

W-S FITTINGS DIVISION

H. K. PORTER COMPANY, INC.
Roselle, New Jersey

# Does your problem call for a Specially Built Coupling?



Specially designed Coupling for use in a wind tunnel

WALDRON Coupling hub with special plate provides required sliding motion

## then put your problem up to

# Waldron

The extensive engineering and manufacturing facilities maintained for the production of our popular standard type couplings put WALDRON in the most favorable position for handling special orders. WALDRON is the recognized source for prompt service on unusual coupling applications.

**JOHN WALDRON CORP. • NEW BRUNSWICK, N. J.**

Sales representative in Principal Cities

STANDARD TYPES — Waldron COUPLINGS — SPECIAL TYPES


duced by the reefs. It was for that reason that I described the many effects which influence gravity surveys and emphasized the importance of experience on the part of the interpreter.

Reefs can be found, but it is not easy.

Richard A. Pohly,
President,
Pohly Exploration Co.
Tulsa.

**New Engines Coming?**

"Gas turbines and free-piston engines for automobiles may affect both our fuel and lubrication markets. Experimental, automobiles powered by gas turbines are already on the highways, and we are naturally paying the closest possible attention to work being done in this field. Radically new engines for automobiles will not come overnight. If they come at all, the changeover will be gradual."

*B. Brewster Jennings, chairman, Socony Mobil Oil Co., Inc., in statement to stockholders, New York.*

**An Individual Job**

"If each of us would try our best to be effective in the leadership of the public opinion with which we are in direct contact day after day after day, jointly and together, we can have profound influence upon the general attitude toward a free market economy."

*Harold Brayman, director, public relations, E. I. du Pont de Nemours & Co., in address before U. S. Chamber of Commerce, Washington, D. C.*

# CALENDAR OF EVENTS

**MAY**

**21-23** American Petroleum Institute, Marketing Division, midyear meeting, Atlanta Biltmore Hotel, Atlanta.

**22-24** Pennsylvania Gas Association, Pocono Manor Inn, Pocono Manor, Pa.

**23-25** American Society of Mechanical Engineers, E.I.C. meeting, Mount Royal Hotel, Montreal.

**24-25** Natural Gas and Petroleum Association of Canada, Sheraton Brock Hotel, Niagara Falls, Ont.

**24-25** Western Petroleum Refiners Association, Michigan Regional Meeting, (location to be announced).

**24-25** Kentucky Oil and Gas Association, annual meeting, Lafayette Hotel, Lexington, Ky.

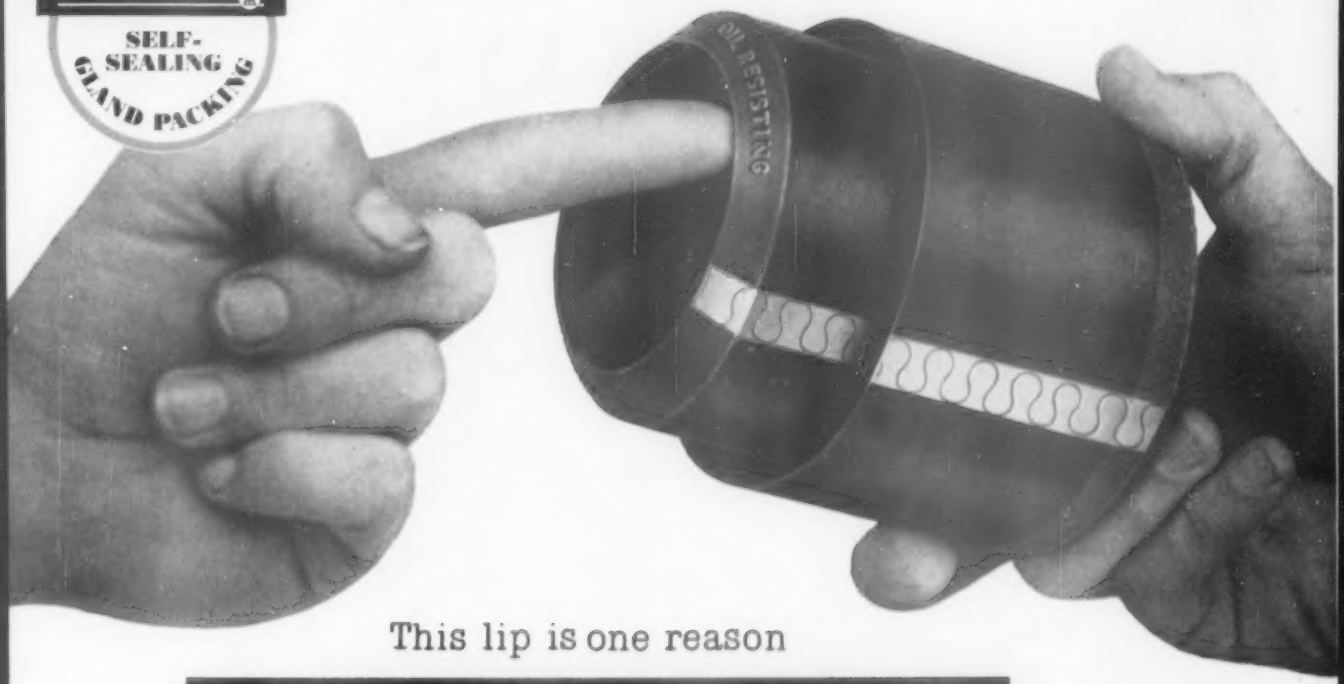
**28-30** Chemical Institute of Canada, 39th annual conference and exhibition, Sheraton-Mount Royal Hotel, Montreal.

**29-June 1** Institution of Gas Engineers, London.

**30-June 1** Texas College of Arts & Industries, eleventh annual short course in Gas Technology, Kingsville, Tex.

MISSION MANUFACTURING CO.

SELF-SEALING GLAND PACKING




This lip is one reason

**Mission Self-Sealing Gland Packings**

make piston rods last longer.

Pump pressure assures positive sealing on the pressure stroke without excessive gland tightening which causes unnecessary wear on the rod during the suction stroke.

Mission Self-Sealing Gland Packings are simple in construction, easy to install and adjust. They cost less per foot of hole drilled as both rods and packing last longer.

Install Mission Self-Sealing Gland Packings the next time you change rods. They are sold through supply stores everywhere.

*Nothing but the finest will bear the name of* MISSION MANUFACTURING CO.

MISSION MANUFACTURING CO. • P. O. Box 4209 • Houston, Texas • Cable Address—"Missco" • Export Office: 30 Rockefeller Plaza, New York
In Great Britain: MISSION MANUFACTURING CO. LTD. • 17 Hanover Square • London, W.1, England • Cable Address—"Missoman"

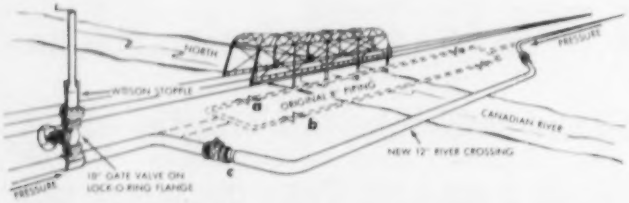
Slush Pump Valves • Valve Springs • Valve Seat Pullers • Pistons • Piston Rods
Liners • Gland Packings • Slips • Swabs • Centrifugal Pumps • Plug Valves

# OKLA. NATURAL GAS RELOCATES 10" LINE *without* INTERRUPTION OF SERVICE

**OKLAHOMA NATURAL GAS COMPANY** MAINTAINED GAS SERVICE TO OKLAHOMA CITY CUSTOMERS WHILE RELOCATING A SECTION OF PIPELINE CROSSING THE NORTH CANADIAN RIVER . . .

HERE'S HOW THE JOB WAS DONE

① TWO 10" FLANGED SPLIT-TEES WERE WELDED TO THE LINE ON EITHER SIDE OF THE RIVER




② TAP WAS MADE WITH WmSON-HILLCO MODEL 660 TAPPING MACHINE

③ WmSON STOPPLE REPLACED TAPPING MACHINE ON CLOSED VALVE

④ LINE WAS PLUGGED ISOLATING SECTION BETWEEN STOPPLE AND VALVES a. & b. (CITY LOOP SYSTEM MAINTAINED SERVICE TO RIVER FROM EACH SIDE.)

⑤ ISOLATED SECTION WAS THEN CUT AND NEW 12" CROSSING TIED INTO 10" LINE

⑥ FOR REMOVAL OF VALVE, LOCK-O-RING PLUG WAS INSTALLED IN L-O-R FLANGE WITH TAPPING MACHINE

⑦ TAPPING MACHINE AND GATE VALVE WERE REMOVED AND BLIND FLANGE INSTALLED

THIS ENTIRE OPERATION WAS THEN REPEATED ON THE OPPOSITE SIDE OF THE RIVER

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30-
**June 2** Interstate Oil Compact Commission, Dallas.

**JUNE**

**3-8** Society of Automotive Engineers, summer meeting, Chalfonte Haddon Hotel, Altantic City, N. J.

6-7 Independent Oil Men's Association, annual convention, Statler Hotel, Boston.

**6-8** American Society for Quality Control, tenth annual convention, Palais du Commerce, Montreal.

7-8 American Petroleum Institute, Oil Industry Information Committee, Conrad Hilton Hotel, Chicago.

**10-15** American Petroleum Institute, Production Division midyear standardization conference, Brown Palace and Cosmopolitan Hotels, Denver.

11 American Gas Association and Independent Natural Gas Association of America, joint meeting of rate committees, Shamrock Hilton Hotel, Houston.

**11-15** American Institute for the Advancement of Science, Gordon Research Conference on Catalysis and Petroleum, Colby Junior College, New London, N. H.

12 A.G.A. rate committee, Shamrock Hilton Hotel, Houston.

13 I.N.G.A.A. rate committee, Shamrock Hilton, Houston.

**13** Pennsylvania Grade Crude Association, thirty-third annual meeting, Bradford, Pa.

14-16 American Society of Mechanical Engineers, applied mechanics conference, University of Illinois, Urbana, Ill.

17-21 American Society of Mechanical Engineers, semiannual meeting, Statler Hotel, Cleveland.

**17-22** American Society for Testing Materials, annual meeting, Chalfonte-Haddon Atlantic City, N. J.

17-23 World Power Conference, Vienna.

21-22 Western Petroleum Refiners Association, regional technical—industrial relations meeting, Broadview Hotel, Wichita.

21-23 American Association of Petroleum Landmen, annual convention, Denver.

25-29 American Institute of Electrical Engineers, 1956 summer and Pacific general meeting, San Francisco.

**26-29** Canadian Gas Association, Manoir Richelieu, Murray Bay, Que.

**28-30** Rocky Mountain Oil and Gas Association, board of directors, Hotel Utah, Salt Lake City.

**JULY**

**9-11** American Gas Association, American Petroleum Institute, Canadian Petroleum Association, committees on natural gas reserves, Banff, Alta.

17-27 Program on Recent Advances in Catalytic Polymerization, Massachusetts Institute of Technology, Cambridge, Mass.

**AUGUST**

**2-4** Rocky Mountain Mineral Law Foundation, Second Annual Institute. University of Colorado, Boulder.

27-29 Sixteenth Annual Gas Measurement Short Course, West Virginia University, Morgantown, W. Va.

**SEPTEMBER**

**9-12** Independent Natural Gas Association of America, annual membership meeting, St. Anthony Hotel, San Antonio, Tex.

**11-13** Pacific Coast Gas Association, annual meeting, Coronado, Calif.

12-14 National Petroleum Association, an-

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nual meeting, Traymore Hotel, Atlantic City, N. J.

**13-15** Chemical Institute of Canada, third Western Regional Conference, Edmonton, Alta.

**16-18** New Mexico Petroleum Industries Committee, annual convention, Hilton Hotel, Albuquerque.

**16-21** American Chemical Society, 130th annual meeting, Atlantic City, N. J.

**17-21** Instrument Society of America, eleventh annual international instrument-automation conference and exhibit, New Coliseum, New York City.

**20-21** Western Petroleum Refiners Association, regional technical-industrial relations meeting, Hotel Henning, Casper, Wyo.

**20-21** Mid-Continent Oil and Gas Association, Louisiana-Arkansas division, annual membership meeting, Roosevelt Hotel, New Orleans.

**24-26** American Society of Mechanical Engineers, petroleum mechanical engineering conference, annual meeting, Statler-Hilton Hotel, Dallas.

**26-28** Rocky Mountain Mineral conference, American Institute of Mining, Metallurgical & Petroleum Engineers, Newhouse Hotel, Salt Lake City.

**OCTOBER**

**2-3** Texas Mid-Continent Oil and Gas Association, thirty-seventh annual meeting, Rice Hotel, Houston.

**2-4** National Association of Corrosion Engineers, south central region, Beaumont.

**7-9** American Association of Oil Well Drilling Contractors, annual meeting, Texas Hotel, Fort Worth.

**11-12** California Natural Gasoline Association, fall meeting, Sheraton Hintington Hotel, Pasadena, Calif.

**14-17** American Institute of Mining, Metallurgical & Petroleum Engineers, Petroleum Branch, fall meeting, Biltmore Hotel, Los Angeles.

**14-20** OIL PROGRESS WEEK.

**15-17** American Gas Association, annual meeting, Atlantic City, N. J.

**18-19** Western Petroleum Refiners Association, regional technical-industrial relations meeting, Rufus Garrett Hotel, El Dorado, Ark.

**18-21** Permian Basin Oil Show, Odessa, Tex.

**22-24** Rocky Mountain Oil and Gas Association, annual convention, Cosmopolitan Hotel, Denver.

**29-Nov. 1** Society of Exploration Geophysicists, national convention, New Orleans.

**NOVEMBER**

**7-8** Philadelphia section, Instrument Society of America, Symposium on Process Data Logging, Stratford Hotel, Philadelphia.

**8-9** American Association of Petroleum Geologists, Society of Exploration Geophysicists, and Society of Economic Paleontologists and Mineralogists, fall meeting, Ambassador Hotel, Los Angeles.

**12-15** American Petroleum Institute, annual convention, Conrad Hilton Hotel, Chicago.

**19-20** American Institute of Mining, Metallurgical & Petroleum Engineers, North Texas Secondary Recovery Symposium, Municipal Auditorium, Wichita Falls.

**25-30** American Society of Mechanical Engineers, Statler Hotel, New York.

**JANUARY (1957)**

**14-16** Pipe Line Contractors Association, ninth annual convention, Boca Raton Hotel and Club, Boca Raton, Fla.

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# JOURNALLY SPEAKING . . .

## Oil G-Men

YOU'VE got to hand it to our federal Government for doing things up brown. When Uncle Sam has a job to do he doesn't mince around with halfway measures. No sir; the Greatest Government in the World spares no taxpayers' expense to accomplish things in a big way.

Take, for example, the investigation of the Interstate Oil Compact Commission. Last year, in a periodic renewal of the Compact, Congress asked the Department of Justice to delegate an observer to the Compact Commission and report on whether or not its activities are injuring consumers by fixing a high price for oil. Since other federal agencies have been sending observers to Compact meetings for many years, this seemed like a modest request.

But the Department of Justice isn't modest. Instead of assigning one observer it wants to assign 110. That's right, 110. And the House has just passed a bill appropriating $962,000 to pay this investigating squad. Since the Compact Commission's annual budget is $100,000, this sum ought to be enough to permit the G-men to make a small start.

However, a problem arises. The Compact Commission has only eight employes, including four girls and a part-time janitor. Obviously it will be a bit awkward to have 110 sleuths looking over the shoulders of eight people, even if they put 24-hour "tails" on them. So other assignments will have to be found for some of the federal dicks.

We predict that it won't take long for the Department of Justice, smart as it is, to discover that the Compact Commission has never done anything about the price of oil—nor much of anything else except issue printed reports and hold public meetings where anybody who wants to can make a speech.

So the squad will be fanned out to the Compact members. And who are the members? Why, just the governors of 26 states. How will the governors react to being tailed by G-men trying to catch them in the act of fixing the price of crude? That we want to see.

Eventually, we presume, the department will realize that the only state conservation activity which could remotely be said to have some possible influence on the price of oil is market-demand proration. So this will become the target of the probe. But it so happens that only 6 of the 26 member states engage in market-demand proration.

Each of these states has a field force engaged in checking up on gas flaring, well plugging, and such routine matters, but having nothing to do with setting proration policy. The policy makers are the members of the state regulatory agencies and their top conservation officials. In Kansas this includes 4 people, in Louisiana 2, in New Mexico 3, in North Dakota 4, in Oklahoma 4, and in Texas 5—a total of 22 suspected villians to be watched by 110 sleuths.

Apparently the far-seeing Department of Justice has already realized that 110 people can't keep very busy watching 22 men. It plans to esconce some of its staff in a field office in California. California has never been a member of the Compact Commission, doesn't prorate oil, and hasn't even any conservation laws worthy of the name.

How these people are going to investigate the Compact from California is beyond us, but we figure they might as well be there as anyplace else for all the good they will do in proving that the Compact rigs the price of crude.

Unless, of course, the whole theory behind this investigation is that any conservation has an effect on price. That will be easy to prove. It won't take 110 investigators to find that there were many times in the past, before states had conservation laws, when oil and gas were dirt cheap. Sure conservation has some effect on supply, and supply has some effect on price. So what?

Any oil man can tell the Department of Justice that the price of oil would go down fast if all conservation laws were repealed and everybody could drill where he wanted, produce as fast as he wanted, and waste as much as he wanted.

Just how long the price would stay low and the supply would remain plentiful under such conditions is the real question. We hope the $962,000 enables the 110 men to answer it once and for all.

*—Henry D. Ralph.*

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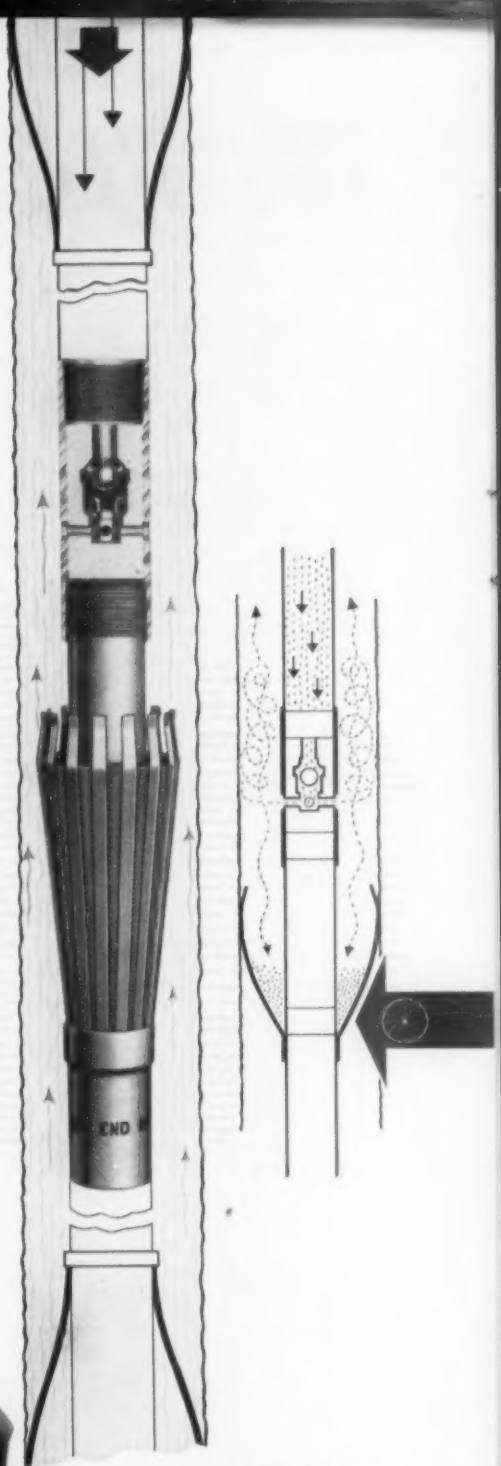


A popular hook-up consists of a Baker Metal Petal Basket mounted on nipple, with a Baker Cement Whirler Float Collar with Solid Baffle (Product No. 305) which whirls the cement slurry outward and upward through the baffled, side-whirler ports.

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**PRODUCT NO. 340**

The overlapping "petals" (each mounted on its individual spring steel rib) provide flexibility and freedom of expansion to pack-off around the circumference of large-diameter holes, or holes of irregular contours.

# Let's face it: Oil will pay for roads

THE oil industry's position on the pending highway bill needs explaining.

As officially taken by the American Petroleum Institute, the industry's stand has puzzled some oil men, particularly those not in the marketing division. Some congressmen, and no doubt a good share of the general public, have jumped to the conclusion that the oil industry is opposed to paying its fair share for highway construction.

The bill now on the verge of passing Congress raises the federal gasoline tax by 1 cent a gallon and allocates the entire 3-cent tax to highway building for the next 16 years. The gasoline tax will supply the big bulk of total funds for the new program.

A.P.I. WITHHELD endorsement of the bill. This despite the conclusions of several recent studies that the gasoline tax is about the fairest and most practical way of collecting highway costs from highway users, and despite the motoring public's apparent willingness to pay more taxes to get better roads.

The industry's position was not opposition to new road building. It was not complete disagreement with the principle that highway users should pay most of the cost in some way. It was an attempt to protect its customers against excessive gasoline taxation.

Gasoline is so easy to tax and yields so much revenue that it is already taxed far out of proportion to most commodities. State gasoline taxes—not all of which go to highways—keep going up. A point could soon be reached where taxes curtail gasoline use.

Federal gasoline taxes originally were imposed as emergency measures for general Government revenue. The industry long fondled the hope that they would be repealed. So its spokesmen felt obliged to register a protest against making them virtually permanent. They declined to endorse a blank check to finance highways from gasoline taxes without assurance that the rate will not keep going up.

Another point was that if Congress is determined to reverse its historic policy and tie user taxes to highway spending, present oil and automotive taxes would finance the program without increases if all of them are so used. Failure to do so looked like discrimination against gasoline.

UNFORTUNATELY, the logic of these arguments was lost amid the overwhelming insistence on getting a roads program started. The public's mood today, as reflected in Congress, is to pay for roads with gasoline taxes.

The industry may as well be realistic and bow to the inevitable. It must get reconciled to the fact that—right or wrong, fair or unfair—gasoline taxes are going to stay high to finance highway construction for a good many years to come.

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# The Industry This Week

**Refining**

• **Start of three-grade gasoline marketing** has U. S. refiners in a switch. All agree 100-octane will spread over the nation much quicker than expected. Question is whether they'll stick to two grades or add a third. P. 134.

**A two-stage fluid catalytic cracking process** has been revealed by Shell Oil Co. Its designers claim the new unit now in use at the Anacortes refinery gives higher gasoline and lower coke yields and offers greater process flexibility. P. 131.

**A 90,000-bbl. expansion** of British Petroleum's Kent refinery is under way. The $73-million project will raise capacity to 140,000 bbl. daily, includes distillation unit, cat reforming, thermal reforming, Hydrofining. P. 146.

**Government**

• **A new federal taxing philosophy** is emerging as Congress considers the highway construction bill. It means that gasoline and other road-user taxes will foot the entire cost. The tax plan has aroused some oil-industry opposition. P. 122.

**Sale of more than 500,000 acres** under Gulf waters was called off last week by Department of Interior. Officials bowed to a temporary restraining order in state court, giving Louisiana first-round victory in dispute over "twilight zone" areas. P. 138.

**Deadline** on successful working of voluntary control on imports has been set for September 1. Failure by then may mean presidential action to protect domestic industry, says Mobilization Director Flemming. P. 141.

**Favorable tax ruling** on oil payments may have cleared $224.6 million deal in which Atlantic Refining will buy Houston Oil. P. 141.

**Drilling—Exploration**

• **One of biggest farmouts** in Canadian history has been taken by Phillips in deal with Canada Southern Petroleum for British Columbia acreage. P. 125.

**Sahara Petroleum has moved** a new rig into Egypt and soon will have three working in the western desert. P. 144.

**The Dresser-Soviet deal** for the Russian turbodrill has been blocked by the Commerce Department which refused Dresser license to export technical data. Dresser would have got 40 turbodrills in exchange for information on manufacture of American rock bits. P. 139.

**Pipelines**

• **Trans-Canada construction start** July 1 is considered practically in the bag. The Canadian Government's closure motion to limit debate cuts off the filibuster threat to the pipeline loan bill. It's expected to pass Parliament before the June 7 deadline, clearing the way for pipe laying to begin on the Alberta-Winnipeg leg. P. 141.

**The swing is on** toward increased use of metering by crude lines. Humble plans soon to replace hand gaging in measuring its lease production into pipelines. P. 142.

**First pipe will be laid** in December on Venezuela's 211-mile, 20-in. crude line from Barinas-Apure basin to the Caribbean. It will mean an outlet for a major interior producing area. P. 144.

# What the Highway Bill Means to Oil

- **A new federal taxing philosophy emerges—gasoline, other road-user levies will be made to foot all the cost**

- **A.P.I. opposes taxing plan for super highway network; claims present revenues sufficient if allocated to roads**

OVER the opposition of the American Petroleum Institute, Congress seems set to adopt an entirely new philosophy of federal gasoline taxing and highway construction.

The new policy is to make highway-user taxes—chiefly gasoline—pay virtually the entire cost of an accelerated program of road building (see table).

States have used this policy quite generally for many years. But federal highway expenditures have always come out of general revenues and have borne no relationship to motorists' taxes. Federal excise taxes on gasoline, tires, automobile sales, etc., have gone into the Treasury's general fund for government operating expenses. They have been imposed as "temporary" or "emergency" revenue measures, with some hope—never realized—of eventual repeal.

Pending legislation reverses this historic policy. The tax on gasoline, diesel, and special motor fuels is increased by 1 cent per gallon to a total of 3 cents. It is pledged to a special highway trust fund for the next 16 years. Congress is to review the program periodically with a view to changes, but the principle of federal road-user taxes to finance highways is firmly established in the legislation.

The A.P.I. opposed this new policy. But practically everybody else who appeared before congressional committees strongly endorsed the principle of taxing users to pay for the highways.

## The Fallon Bill

The House passed the Fallon highway bill April 27 by a vote of 388 to 19. The Senate version, the Gore bill, differs from the Fallon bill in the construction program, appropriations schedule, and other features. The Senate finance committee last week held 2 days of hearings on the tax provisions, which appear likely to conform with the House version.

After finance committee action, the bill will go to the Senate floor for a vote. Because of various differences between the two versions, the measure then will have to go to a conference committee.

But it's a safe bet that Congress will enact the new policy of making the gasoline the chief source of federal highway funds. The Fallon bill authorizes $51.5 billion of highway construction during the next 13 to 15 years. The federal Government will pay $37.3 billion and the balance will come from the states.

**Tax schedule . . .** New gasoline and other road-user taxes will be imposed beginning July 1, 1956.

Appropriations will be spread over 13 years, construction over 15 year, and collections over 16 years. The new taxes will end June 30, 1972. The gasoline tax will revert to 1.5 cents per gallon at that time—in the absence of further legislation.

In addition to the new taxes, some existing highway-user taxes will be allocated to the trust fund. Other present oil and automotive taxes are not pledged to highways, and will continue to be available for general government expenses.

In the gasoline and other new taxes there are provisions for exemptions for farm, industrial, and other nonhighway uses. This is to carry out the principle that highways are to be paid completely by highway users and not by anyone else.

**Interstate system . . .** The most dramatic feature of the Fallon bill is the National System of Interstate and Defense Highways.

It is 40,000 miles of limited-access freeways, mostly four and six-lane divided highways. It will connect 42 state capitals and 90 per cent of all cities over 50,000 population. It constitutes 1.2 per cent of the nation's

## Where the Money Will Come From

**(Fiscal Years 1957-72 in millions of dollars)**

| | Present taxes | | New taxes | | Total allocated amount |
|---|---|---|---|---|---|
| | Rate | Amount | Rate | Amount | |
| Gasoline | 2¢/gal. | 19,561 | 1¢/gal. | 9,295 | 28,856 |
| Diesel fuel | 2¢/gal. | 535 | 1¢/gal. | 251 | 786 |
| Tires | 5¢/lb. | 3,435 | 3¢/lb. | 1,909 | 5,344 |
| Inner tubes | 9¢/lb. | 153 | | | 153 |
| Retread rubber | | | 3¢/lb. | 180 | 180 |
| Trucks, buses, trailers | | | 3%* | 1,350 | 1,350 |
| Trucks, buses, trailers | | | 2% | 957 | 957 |
| Trucks (over 26,000 lb.) | | | $1.50/M. lb. | 866 | 866 |
| Total allocated | | 23,684 | | 14,808 | 38,492 |

***This 3 per cent is a part of the current rate of 8 per cent factor sales price on trucks, but it is included under new taxes since it would expire March 31, 1957, unless reestablished by law.**

## How it will be Spent

**(Projected appropriations during next 13 years)**

| | Billions |
|---|---|
| Interstate system: | |
| Federal funds | $25.0 |
| State funds | 2.0 |
| Primary and secondary systems: | |
| Federal funds | 10.5 |
| State funds | 10.5 |
| Public lands roads: | |
| Federal funds | 1.2 |
| Miscellaneous (plus odd figures not included in above roundings) | 2.3 |
| Total program | $51.5 |

road mileage, but is expected to carry 20 per cent of the traffic load.

This interstate system will be financed 90 per cent by the federal Government, 10 per cent by the states. Around 45 per cent of the cost will be expressways through or around cities. Allocations to the states under the House version will be on the basis of construction needs rather than the old formula of population, which the Senate bill now has.

Construction of the interstate system must conform to the standards of the federal Bureau of Public Roads. States must agree to limit the number of access and exit points, and to deny use of the system to trucks over a maximum weight. Service stations and commercial establishments may not be built on the right-of-way. States may not permit any oil company to have a monopoly of the service-station business —thus ending the practice of competitive bidding for exclusive station locations along expressways and toll roads.

The federal share of the interstate system is $24.825 billion. The rest of the $37.3 billion will go to increasing federal aid under other, old programs, plus some purely federal road construction on the public domain, such as national forests and parks.

**Primary and secondary roads . . .** Federal aid to the so-called primary and secondary highway systems, and the extensions of both in urban areas, will continue to be matched 50-50 by the states.

These systems will not have the restrictions that are applied to the new interstate system regarding limited access and filling stations on the right-of-way.

**Ideas behind the bill . . .** The urgent need for a whole new approach to the highway problem was taken for granted by just about every member of Congress and witness before congressional committees.

Various plans have been kicked around in Congress for several years. The Fallon bill is an attempt to get off dead center by adopting these principles:

**. . . Finance new construction** out of highway-user taxes rather than general revenues.

**. . . Locate the new interstate** throughway system on the basis of traffic needs and construct it on the basis of the most modern engineering studies.

**. . . Put the whole $51.5 billion,** 15-year program into a "package deal" to permit long-range planning, efficient construction, and freedom from future political pressures.

**. . . Finance the program** during the construction period on a "pay-as-you-build" plan rather than a "pay-as-you-ride" plan such as 30-year bonds or just plain optimism that the money could be found somewhere when and as needed.

**. . . Make changes** in the plan later if certain features don't work out as expected. The bill directs that several studies be conducted and reports made to Congress on controversial features. One of these is the proper allocation of highway-user taxes in order to place the burden equitably on those who get the most benefit from the highways.

## Related Taxes Not Allocated

**(Fiscal years 1957-72 in millions of dollars)**

| | Rate | Amount |
|---|---|---|
| Lubricating oils | 6¢/gal. | 759 |
| Passenger cars | 10%-7%* | 11,284 |
| Trucks, buses, and trailers | 8%-5%* | 2,468 |
| Parts and accessories | 8%-5%* | 2,753 |
| Total | | 17,264 |

***The first percentage figure is the current rate, which under present law drops to the second percentage number in 1957.**

## The Controversy

There was—and still is—much controversy over many provisions and ramifications of the Fallon bill. But most people who raised serious objections agreed to go along with the program in the interest of getting things moving. The program is so far-reaching that virtually every business interest in the nation is affected by it in various ways—both good and bad.

**A.P.I. position . . .** The A.P.I. spokesman before the House ways and means committee was Robert H. Scholl, vice president of Esso Standard Oil Co. In general, Scholl expressed neutrality. But he said the A.P.I. opposed the financing plan and that this was the view of a majority of the nation's oil men.

The A.P.I. position, in a nutshell, was:

**. . . No change should be made** in the historic policy of financing federal public works, such as roads, out of general revenues, because the nation as a whole benefits.

**. . . Federal gasoline taxes** were imposed for general revenue and ought not to be allocated to highways, although

it is perfectly all right for states to do this.

**... Federal taxes on highway users** are already yielding enough revenue to finance the Fallon bill's program if they were allocated for that purpose, so the gasoline tax should not be raised.

**... If any highway-user taxes,** such as on gasoline, are allocated to roads, then all of them should be; and if this creates a deficit in the general fund, then other general taxes should be raised.

**... The combination** of federal and state gasoline taxes is so high that poor people are already suffering under them and any increase may curtail gasoline consumption.

**... Many gasoline buyers** won't use the new interstate system much so they shouldn't be taxed to pay for it.

There was virtually unanimous agreement by everybody discussing the Fallon bill that highways must be built without unbalancing the federal budget. This was in contrast to various other road plans under discussion during the past couple of years.

Also it was generally agreed that the general budget could stand the loss of some of the present highway-user taxes but not all of them, and not enough to finance the whole program.

That's why the A.P.I. suggestion got scant consideration.

**The drawback . . .** It was admitted, as the A.P.I. said, that if all federal automotive and petroleum excise taxes were assigned to the highway trust fund there would be no need for additional taxes for roads. This group of taxes is estimated to yield $41 billion during the 16-year period.

But it was also obvious that if this were done it would be necessary to increase income taxes or other federal levies to make up the resulting deficit in the general budget.

Both the Treasury and the ways and means committee felt that it would be fairer and more acceptable to increase certain highway-user taxes specifically for roads—a conclusion which drew little objection except from the A.P.I.

**Highway study . . .** One of the most detailed studies on highway problems in recent months is that of the Committee for Economic Development, a nonprofit research organization financed by businessmen.

All but oil-industry representatives on the C.E.D. agreed:

**... State and federal governments** should rely mainly on user charges—chiefly gasoline and diesel-fuel taxes—to finance rapid modernization of the nation's highways.

**... The federal Government's** share should be increased.

**... User revenues** should be devoted to highway improvement.

**... User taxes are preferable** to financing roads by going into debt or by increasing general revenues.

**... To crowd the financing** into the 10-year "crash program" of major construction would require too steep an increase in user taxes, so they should spread over 20 years. (The Fallon bill takes 16 years.)

**... The federal tax on gasoline** should be increased 1 cent.

"It would be unreasonable to expect that other federal highway-user charges will reduce in any significant way the dependence of the federal Government on motor-fuel and motor-oil charges for highway financing," the C.E.D. report says.

"No other single user charge measures with comparable precision the extent of a highway user's use of the highways. No alternative user charge offers as efficient a means of collecting a large revenue. . . On balance there are fewer inequities involved in a major reliance on motor-fuel taxes to finance the federal share of highway improvements than there are in alternative sources of revenue."

**A.P.I. dissent . . .** A minority report was filed by the oil-industry members of the policy committee, M. J. Rathbone, president of Standard Oil Co. (N. J.), and J. E. Crane, vice president of Jersey.

"We believe that if an enlarged program of federal highways is justified, it is on the grounds of general national interest and widespread benefits to our country as a whole, not just to those persons who use the roads for their personal or business transportation," they said.

"Consequently, the financing burden arising from such a program should be dispersed over the widest area. Users of highways are already bearing a dispro-

portionate load of selective excise taxes (considering state gasoline taxes) . . .

"If additional funds are to be provided for a federal highway program, they should come from the general revenues of the federal Government, rather than from the discriminatory increase of the federal excise gasoline tax . . .

"Instead of an increase, we hope eventually it will be possible to attain a decrease in the federal gasoline tax."

**A.P.I. backers . . .** Throughout all this year's hearings on the highway problem, the A.P.I. position found only two supporters.

The National Oil Jobbers Council advocated:

. . . **No increase** in the gasoline tax.

. . . **The federal Government withdraw** from the field of gasoline taxation and leave it to the states.

. . . **If highway users** are to be "saddled" with the entire cost, all federal oil and automotive taxes should be used for this purpose instead of imposing new taxes.

The American Farm Bureau Federation took this stand:

. . . **Repeal the federal tax** on gasoline and let the states increase their gasoline taxes proportionately.

. . . **Notify the states** that highways are their responsibility and there will be no more federal aid for roads.

**The other side . . .** In contrast to the A.P.I.'s position, a big parade of industry spokesmen endorsed the principles of the Fallon bill and its financing plan.

Some of these interests preferred a somewhat different allocation of the tax burden or complained about certain provisions of the bill, but said they were willing to waive their objections—at least until further studies can be completed—to get the program moving.

Many of these groups are big highway users and big taxpayers. The list included the American Trucking Associations, Inc.; National Association of Motor Bus Operators; Rubber Manufacturers Association, Inc.; Association of American Railroads; National Grange; American Automobile Association; Chamber of Commerce of the United States; and American Automobile Manufacturers Association."

# Louisiana May Hike Gas Taxes

## ● Long's "No increase in taxes" administration backs new levy on producers during opening day of legislature

BATON ROUGE. — The Louisiana natural-gas industry last week faced the threat of a state tax increase estimated to total $30 million or $35 million annually.

The threat came in the form of a revenue measure introduced by State Sen. C. H. Downs on opening day of the 1956 legislatve session. Downs, representing the Alexandria district, is a floor leader under the new administration of Gov. Earl K. Long, who campaigned on a platform pledging "no increase in taxes."

Downs bill would boost the gas-gathering tax from the present 1 cent to 3½ cents per M.c.f. One cent of the new tax would go into the state general fund and the rest would be credited to the public school fund.

Exempted from the proposed tax increase is gas used in secondary recovery and pressure maintenance, that used as fuel in drilling and producing in gas-producing fields, and flare gas.

**Governor no help . . .** Long gave the industry little solace when, minutes after taking the oath of office for the third time, he hinted that new taxes might be levied.

"I admit that I am pledged within reason not to increase taxes," the new governor declared in his inaugural address. But he pointed out that since his election Louisiana voters had approved a constitutional amendment diverting $15 million in oil revenue from general state expenses to a long-range highway program.

"I warned the people against that amendment," Long said.

In another test of legislative sentiment toward higher taxes, Long forces voted down a resolution putting the state on record as "unalterably opposed to any increase in taxes during this session of the legislature." The resolution was tabled 29 to 7.

Outgoing Gov. Robert Kennon left a surplus in the state treasury estimated at more than $30 million.

## Esso Building Powerformer

EVERETT, Mass.—Esso Standard Oil Co. is adding a 7,200-bbl. Powerforming unit at its 55,000-bbl. refinery here.

Badger Manufacturing Co., Cambridge, will build the unit, which is expected to be on stream by mid-1957.

Powerformers are now in operation at Esso's Baltimore refinery and at Imperial Oil Co., Ltd.'s Edmonton plant. Fourteen others are under construction.

# Canadian Deal Made

## ● Phillips signs pact for Canada Southern acreage in upper British Columbia

NEW YORK. — Phillips Petroleum Co. last week took on one of the biggest farmout deals in the history of the Canadian oil industry when it agreed to explore and develop British Columbia acreage held by Canada Southern Petroleum, Ltd.

Canada Southern, which has a net 1,367,000 acres of a total of 2,000,000 acres of exploration permits in northeast British Columbia, retains a 50 per cent net profit interest.

Under a contract signed by the two companies last week, Phillips agrees to pay all exploratory and development expenses.

The acreage has been divided into 15 separate blocks, with Canada Southern retaining half interest in profits from each.

Phillips, under terms of the agreement, must carry on drilling operations at the same rate as companies operating on adjacent properties or acreage in the same general area.

This latter provision is designed to insure rapid development of the Canada Southern acreage since Gulf, Imperial Oil, El Paso Natural Gas, Shell, and Pacific Petroleums all have acreage near the Canada Southern blocks, and British Columbia's exploration is beginning to boom.

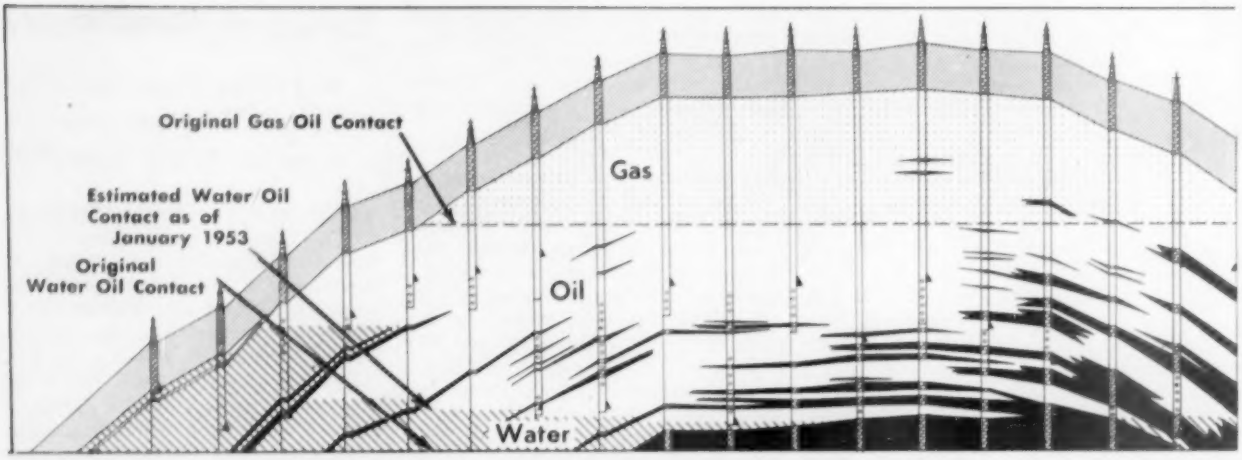
**Unique feature . . .** Phillips also agreed to pay Canada Southern ½ cent per 1,000 cu. ft. of gas reserves already proved and yet to be proved on a 25,000-acre block about 70 miles north of Fort St. John on the Alaskan Highway.

Canada Southern made an important gas-distillate strike last year in this area, now known as Blueberry River field. The discovery well is shut-in because of its remote location.

The rank wildcat found three potential pay zones. Showing in Lower Cretaceous was marginal. The Mississippian flowed initially at rates up to 10,000,600 cu. ft. daily, but fell off.

The well was finally plugged back to 4,650 ft. and completed in the Triassic, where it flowed at a rate of 5,000,000 cu. ft. daily on a drill-stem test. Total depth was 7,500 ft.

John W. Buckley, president of Canada Southern, said last week that the ½-cent gas-reserve payment for this area could easily amount to "several million dollars."




*This cross-section shows how complicated a water-flood project can get. Solving the*

# Magnolia Field—Model for Exact

**● A long-dreamed-of unitization is finally a reality. It took more than 4 years of research and planning, but the program just starting will add 31,000,000 bbl. to ultimate recovery.**

**Robert J. Enright**

MAGNOLIA, Ark.—The day of ultra-engineered pressure-maintenance projects in major oil fields is definitely here.

In the past couple of years, a sizable number of giant oil fields in this country have seen such programs get under way—pools like Kelly-Snyder, Goldsmith, Levelland, Diamond M, and Sharon Ridge.

Now comes another which may surpass any in operation so far as precise control of reservoir performance and of field contacts is concerned.

This is Magnolia field, 5 miles east of here, a prolific Smackover limestone reservoir.

The project is unusual, too, in that a water-injection program has been in operation in the field on a non-unitized basis for more than 10 years.

The Magnolia unit was born officially in April with the blessing of the Arkansas Oil and Gas Commission to put the big pressure-maintenance plan into operation. Atlantic Refining Co. is unit operator.

Atlantic has already taken over the production operation in the 4,000-acre-plus field and is shutting in the inefficient wells—the high gas-oil ratio wells and heavy water producers. By so doing, the unit is reducing gas and water voidage and hiking oil output without further lowering pressure.

Actual installation work will begin in a few weeks, and the entire program should be completely developed in about a year.

**What is involved . . .** Magnolia differs from Kelly-Snyder, Goldsmith, and the others, which originally produced their oil via solution gas drive—accepted universally as the poorest type of natural producing mechanism.

Magnolia, like most Smackover reservoirs, has a limited water drive. This would appear to make things easier but instead has presented a crop of engineering problems not encountered in some of the other large pools.

Formation water at Magnolia isn't entering the pay as fast as fluids are being produced, thus promoting bottom-hole pressure decline. The water also is encroaching from high on the flanks faster than in the lower porous intervals of the pool.

Furthermore, producers in the field are plagued with a bad condition which stems from some portions of the pay being much less permeable and porous than others. These less permeable zones mostly take the form of wedges and stringers extending up and in from the bottom of the pay.

The stringers have caused wide variations in the depth of the water-oil contact, especially along the flanks. Water advancing faster through the most permeable and porous sections threatens to bypass and trap large volumes of oil. If this happens, the oil will be lost forever.

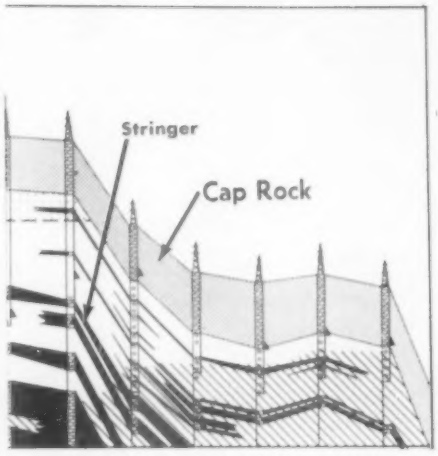
To prevent this meant undertaking a formidable engineering task. The stringers had to be mapped accurately. The erratic oil-water contact had to be pinned down. Water would have to be injected in just the right places and in carefully controlled volumes. Producing wells in a large number of cases would have to be recompleted at carefully calculated locations and depths. Producing rates of big water producers and high gas-oil ratio wells would have to be controlled tightly. There were many, many other complications.

The big questions were: Could these things be done and was it worth the effort in comparison with the return that could be expected? The operators decided that it could be done and that the effort would be worth it to the tune of 31,000,000 bbl. of added oil.

The recovery program, which developed from exhaustive engineering investigations, calls for:

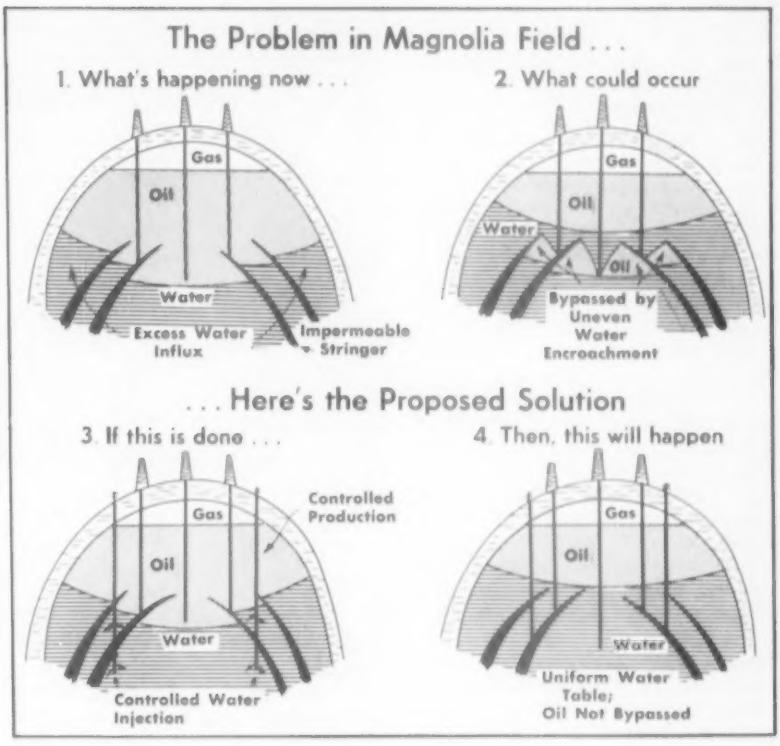
**. . . Revamping** an existing water-injection setup to halt or minimize uneven water encroachment into the Reynolds producing member of the Smackover between the subsea depths of 6,990 and 7,350 ft.

The new water-injection plan will minimize bypassing of oil by the water. It will maintain bottom-hole pressure, stop expansion of the gas cap, and prevent dissolved gas from coming




*problems here make . . .*

# Engineering


The Problem in Magnolia Field . . .
1. What's happening now . . .
2. What could occur
Gas
Oil
Water
Excess Water Influx
Impermeable Stringer
Bypassed by Uneven Water Encroachment
. . . Here's the Proposed Solution
3. If this is done . . .
4. Then, this will happen
Controlled Production
Controlled Water Injection
Uniform Water Table; Oil Not Bypassed

out of solution with the oil in the reservoir.

The flood front will be evened and controlled by careful selection of producing and injection wells and intervals, control of individual well producing and injection rates, and by shutting in big water producers and high gas-oil ratio wells.

**. . . Maintaining gas-cap size** by injecting gas into the cap. Due to bottom-hole decline, the gas cap has expanded, causing an increasing number of wells to produce some gas-cap gas.

Unitized operation can't eliminate all gas-cap production. With pressure being maintained by water injection this gas-cap production would cause the cap to shrink. If it should shrink to less than its original size, oil would migrate into the vacated space which never before had contained oil. A large volume of it, roughly 34 per cent, would remain in the gas cap as residual oil and could never be recovered.

**. . . Possible cycling** of gas cap in the future. This would increase recovery of liquids by preventing retrograde condensation in the cap.

Condensation would occur in the latter stages of reservoir production when pressure was again declining. Whether cycling will be undertaken depends upon a number of factors.

**Injection and production . . .** In March, just prior to official unitization, about 25,400 bbl. of water was being injected daily into the Smackover through four input wells on the flanks of the structure in a cooperative injection program launched in the mid-40's.

The unit contemplates injecting considerably less water to start with under the new program, due to high production efficiency resulting from shutting in the large volume water and gas producers.

Water production in March ran about 11,000 bbl. a day—roughly 60 per cent of total production. A negligible amount of salt water and gas-cap gas will be produced under the new program, thus hiking efficiency of each barrel of water injected.

The unit, along with increasing its ultimate crude take from the field, is getting a substantial and highly desirable boost in immediate daily oil production. Production in March ran 7,403 bbl. daily. The field allowable was 7,900 bbl. daily.

The top per-well allowable just prior to unitization was 101 bbl. a day for a normal well not penalized by excessive water or gas production. By cutting the water and gas production, the unit already has in effect made each of the pool's 104 wells a top pre-unit allowable producer. This would mean a 10,500-bbl. daily allowable for the unit under previous proration limits.

The Arkansas commission has approved a hike in field allowable to 12,500 bbl. daily. This is contingent on the unit being able to market that much oil. The allowable, however, has been boosted temporarily only to 10,000 bbl. daily due to the inability of the crude-oil gathering companies to take more than this volume at present.

Atlantic, as operator, is now producing this 10,000 bbl. daily with the same field production staff it employed to produce its 2,000 bbl. daily share of field output before the unit was formed.

**How it happened . . .** Magnolia's Smackover reservoir, an anticline 6 miles long and 1½ miles wide, was discovered in 1938 based on logs of early shallow wells drilled in the area and reflection siesmograph work during late 1935 and early 1936. The discovery was completed by Kerr-Lynn Oil Co.

Development on 40-acre spacing resulted in completion of 116 producers over 4,300 acres by the first of 1942. Average producing depth of the wells is 7,500 ft. The Smackover's oil pay originally had a maximum thickness of 185 ft. and was overlain by a gas cap with a maximum thickness of 106 ft.

In spite of the natural water drive, the influx of fluid into the reservoir almost from the start didn't keep pace with fluid withdrawals. Bottom-hole pressure started a steady drop. With pressure falling, the gas cap began to expand and more gas began to come out of solution with oil.

The Arkansas commission in 1943 became alarmed over sharply declining pressure in the field and imposed severe gas-oil ratio and water-production penalties after a series of meetings with the operators.

With such an incentive, the operators

joined to form the Magnolia Pressure Maintenance and Salt Water Disposal System with Carter Oil Co. as operator. Roughly $675,000 was invested through this group to halt the pressure drop.

Four injection wells were drilled in a block shape on the northeast, northwest, southeast, and southwest flanks of the reservoir outside the oil column. The four inputs were to inject all produced salt water plus make-up water from shallower sands which do not produce oil. The flood, which was started January 31, 1945, was designed to supplement, not change, the natural water drive.

The Arkansas commission in October of 1946 was shown that the system was working well, and the stringent water-penalty ratio was relaxed. Between 1938 and 1945 before injection started, operators were producing 65,000 bbl. of oil for each pound of pressure drop. From 1945 (when injection began) to 1955, they produced 150,000 bbl. for each pound drop in pressure.

**Troubles begin . . .** A few years later, however, it could be seen that supplementing the natural water drive wasn't the final solution.

Water was coming faster on the flanks and some wells were showing rapid increases in water production.

The disposal system worked hard to find some way of balancing water injection to counteract uneven water influx, but couldn't find a solution acceptable to all operators. This soon made it clear the unitization might be the only way out.

**Engineering begins . . .** Early in 1952, the operators appointed a steering committee which in turn appointed geological, engineering, and legal committees to study all phases of the pressure-maintenance problem.

The geologists constructed structure maps and cross sections of the reservoir along each north-south and east-west line of producing wells.

A team of top engineers, ranging from 6 to 12, worked continuously on the problem from early in 1952 to September of 1953 to get over the hump, then met periodically until September 1954.

The charge to the engineers was: (1) to project future reservoir performance and recoveries under competitive vs. unitized operation; (2) to determine the desirability of unitizatiton; and (3) to provide basic factors for developing an equity formula.

One of the most vexing problems was to find a realistic approach to porosity and permeability. Averages across the reservoir were obviously out of the question because of the many erratically located stringers.

The committee amassed great heaps of porosity and permeability data. It zoned the pool for porosity by reservoir contours, by vertical and horizontal sections, and other ways. It finally came up with what it believed was a workable system by dividing the reservoir into three horizontal sections for porosity and net pay calculations.

Correlating permeability was even worse. The engineers had much less data on this than on porosity.

Use of well logs alone as tools with which to set up connate water valves for the pool proved unsatisfactory. The engineers ran capillary pressure correlations between permeability and connate water using available cores. They studied pressure volume tests conducted by the Bureau of Mines and by Carter.

They made exhaustive studies of the past performance of the field and of the recovery mechanisms at work there. Each producer submitted completion and production figures on each well to Carter Oil, chairman of the committee. All Arkansas Oil and Gas Commission records on runs and other information concerning the field were microfilmed, then carefully tabulated and reviewed.

The engineers worked with material balance and empirical equation to calculate efficiency of the initial water flood and movement of the reservoir gas-oil contact. Considerable time was spent developing an equation to calculate saturation changes in the oil column.

The committee calculated gross pay, net pay, and oil and gas in place. To do the latter, the engineers had to have a sample of the gas-cap gas. Operators kicked in money to test the gas cap in a well which was to be recompleted. The gas cap was perforated, a sample collected, and the well recompleted in a shallower producing horizon. Analyses were run on this sample.

**Plans compared . . .** With all this data, the committee concentrated on finding what could be done to most improve reservoir producing efficiency.

The committee studied a number of secondary-recovery programs, under both competitive and unit operations of the reservoir. It isolated the most promising plans under both types of operation and compared them as to ultimate recovery, immediate production increases, economics, and other factors.

From this vast engineering effort, it found that the program now being adopted under unit operation would recover 31,000,000 bbl. more oil from Magnolia than the best-looking competitive plan.

The field has already produced roughly 82,000,000 bbl.

The committee's findings erased any lingering misgivings about unit operation on the part of most of the producers in the field not sold on it.

Atlantic engineers took over at this point in September of 1954 and have worked constantly on the program since, with never less than two engineers on the job and occasionally as many as eight.

These men have been developing the broad program plan laid out by the engineering committee. They are working out final details as to the selection of inputs and producing and injection intervals, the number and location of water-supply wells, and the blueprints on layout of surface facilities.

**The unit . . .** Magnolia field now is 100 per cent unitized due to Arkansas' compulsory unitization law. Prior to the official operational switch, more than 90 per cent of working interests and more than 77 per cent of royalty interests had signed the unit agreement.

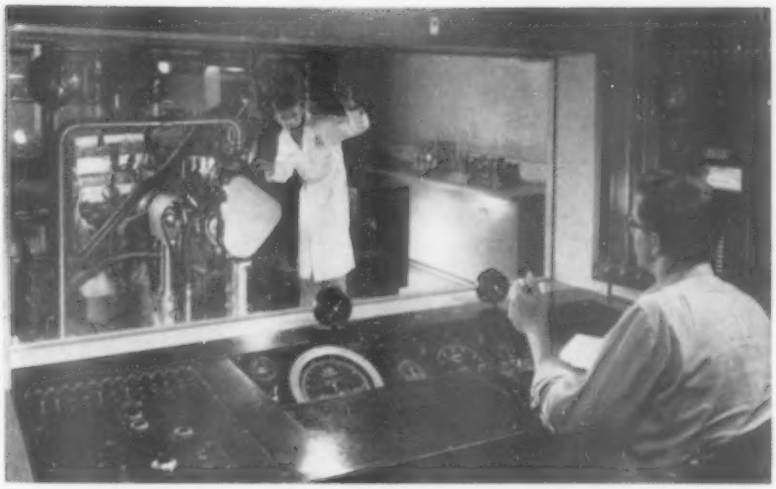
There was no opposition to the program at the unit hearing from royalty holders and only one objection on the working-interest side.

Rounding up the required percentage of royalty signers (75 per cent in Arkansas) proved a big job in itself, since there are about 470 of these in 22 states and some even out of the country. The job took about 9 months.

Participation in the unit is calculated via a formula based on remaining net acre-feet of pay and average daily oil production between January 1 and June 30, 1953.

Operator Atlantic's working interest is a little over 28 per cent. Carter's is about 22 per cent, Shell Oil Co. and the Vaughn interests each between 10 and 11 per cent.

Ten others have more than 1 per cent each. There are more than 40 participating companies and individuals holding working interests in the unit.



**THIS DYNAMOMETER CELL handles typical laboratory tests conducted on both production and experimental auto engines at General Motors big new Detroit technical center. Instruments and control console can be seen outside the cell.**

# Fuel Trends to Hold

## No radical changes, just steady improvements indicated by engine and lubrication experts at big technical center

DETROIT.—The oil industry within the foreseeable future is not faced with revolutionary changes in engine design which will bring changes in existing trends in motor fuel and motor oil specifications.

And the demand for those products, steadily improved in quality for more exacting uses, will continue to expand.

These conclusions appear fully justified at the end of a day devoted to the formal dedication of a $100 million technical center of General Motors Corp., 15 miles from the center of this city.

These ceremonies, sponsored by the company which is the largest manufacturer of oil-consuming products, were held May 16.

The addresses of executive and research heads of the center, and visits to the 25 buildings which comprise it, left no doubt that, in the main, the activities of the world's largest research and development organization will continue to be centered "in doing better what we are already doing."

While not discussed by the speakers in the field of motor fuels, this can be interpreted to mean higher antiknock specifications, with probably more emphasis on road and laboratory tests.

In lubricants, General Motors researchers, who take credit for the introduction of the "W" multipurpose oils, want further improvement. They also seek solutions to lubricating problems that have arisen because of changes in mechanical design.

In diesel fuel, the largest manufacturer of diesel power seeks improved oils for specific uses. The center is also striving to make changes in designs which will permit widening use of the cheapest grades of diesel fuel.

**New-products research . . .** All this does not mean there is no research going on at the center which might not bring changes in petroleum products.

In fact, two of the half-dozen major exhibits of direct interest to the oil industry stole the show, based on interest displayed by 5,000 invited leaders in industry, science, education, and the military.

One of these was the much-publicized XP-500, the first automobile powered by a free-piston engine. The other was the equally famed dream car, Firebird II.

The latter, built of titanium and powered by a gas-turbine engine with jet aircraft styling, is said to be the most expensive automobile ever built, largely because of the cost of titanium and the high costs involved in its initial use in body manufacture.

It was explained that the free-piston engine is in the "early experimental stages" and there is no evidence that the testing of the gas-turbine engine in the various types of motor vehicles points to important commercial uses soon in that field. But, indicative of possible long trends, one building is devoted to the gas turbine.

While not shown or discussed, it is known that the center is doing considerable work with this type fuel. But here also, the start and scope of significant commercial uses is in doubt.

The XP-500 and the GM-14 were shown with cross-sections as one of the principal new exhibits at the center.

**Maritime prototype . . .** The GM-14 is a free-piston gasifier designed for ship propulsion. It is the prototype of six free-piston gasifiers. General Motors is supplying a unit to Maritime Administration for installation in a converted Liberty ship.

The two exhibits are the result of 3 years of testing by General Motors of a 30-year-old principle.

The XP-500 power plant represents an entirely new concept in automotive power. The engine has no crankshaft or connecting rods, and no rotating parts in the manner of a conventional automobile engine.

Its pistons operate like a bicycle pump, blowing hot gases through a pipe to a turbine which, by spinning, powers the rear wheels. The engine consists of two parallel cylinders, each containing a set of two horizontally opposed pistons.

An air fuel charge fired between the pistons drives the pistons apart, compressing air at the ends of the cylinders. The compressed air bounces the pistons back toward inner dead center, and as they travel inward they also compress air that pumps a diesel cylinder.

The back-and-forth movement continues to compress air, which is piped to a turbine in the rear compartment that is combined with the transmission axle unit, transmitting power to the rear wheels.

**Versatile engine . . .** So far as the oil industry is concerned, the main interest in this development lies in the fact that the engine has been operated with petroleum fractions extending from high octane gasoline to heavy fuel oil. It has, in fact, been fueled with whale oil and vegetable oils.

It is pointed out that it has advantages over the gas-turbine engine in that the exhaust gases which go to the turbine are comparatively cool.

This means the blades can be made of noncritical and cheaper materials. It is also emphasized that the engine has fewer rotating parts than the conventional engine.

The technical center has three divisions—research, engineering and manufacturing, and styling.

**REFINERS REGISTER AT MONTREAL for the annual meeting of the A.P.I. Division of Refining. Registrants totaled about 1,650, including 500 Canadian members. Canada's A.P.I. hosts were credited with one of the most successful midyear meetings on record.**

# Computer Uses Growing

## Computer models representing complete refineries supply operating data now requiring years of experience to gain

MONTREAL.—Digital computers promise to become a valuable tool in planning over-all refining operations.

They already have an important role in handling refinery data and in simulating various refinery processes. Now the trend is to combine models of separate processes to represent complete refineries. And some setups are even bringing into the picture such company operations as supply, transportation, and marketing.

The calculations provide data pointing to improved operating practices. And the experiments attract refiners for two big reasons: They are cheap; they can be made with no disruption of actual operations.

These prospects were reported here last week during a session on computers at the midyear meeting of the American Petroleum Institute's Division of Refining.

R. G. Donovan, Esso Standard Oil Co., Linden, N. J., reported new mathematical methods are gaining recognition. They are called operations-research and many are well suited to high-speed computing adaptable to refinery processing.

One method permits simulation of random refining processes, condensing years of future experience into minutes of computer time. Other techniques provide for optimizing various refinery operations through completely automatic computer calculations.

**Operations scheduling . . .** Large-scale electronic computers may be used to schedule refining operations more efficiently, Jack Sherman, The Texas Co., Houston, reported.

The modern refinery uses a wide variety of processes to turn out a number of highly refined products. At the outset it is not evident how these operations should be tied together to make the desired finished products most efficiently. Many alternative possibilities generally exist. The most desirable one to use can best be determined by making a large number of calculations.

In the past these calculations could not be carried out adequately because they are so extensive that the time involved would have been prohibitive. However, the high-speed computer greatly increases the amount of computation which it is practical to perform, Sherman said.

In addition to this basic application of a high-speed computer to refinery operations, others are being made. These include the engineering design calculations of new equipment and economic studies of new equipment.

Applying large-scale computers to refining problems also results in more efficient use of engineers and chemists. They are freed from the drudgery of time-consuming, routine work.

**Heat-exchanger design . . .** Complete shell-and-tube heat exchangers are now being designed in a routine manner by M. W. Kellogg Co. on automatic digital computing equipment, A. M. Peiser of Kellogg's Jersey City, N. J., laboratories said.

Limitations of present equipment restrict the applications to single-phase, turbulent flow of fluids in both the shell and tube sides. Within this area, however, a wide variety of designs has been carried out, encompassing any combination of hydrocarbons, water, or water solutions as the heat-exchanging media, he said.

When a magnetic drum-type calculator is obtained in the near future, the program will be extended to include all combinations of single or multiphase flow, in either the viscous or the turbulent region.

The use of computers in this application has resulted in three significant advantages:

. . . **Schedules:** Use of the computer has enabled the heat-exchanger engineers to meet schedules that would either not have been met, or would have required extensive overtime.

. . . **Costs:** Experience to date indicates that one computer hour is equiv-

alent to about 15 man hours, which means considerable saving in the cost of designing a heat exchanger.

. . . **Information:** The capacity to examine various alternatives in a given design is greatly increased. Thus, for a given cost, it is possible to obtain more information more quickly than has been possible before, Peiser said.

**Integrated solution . . .** Humble Oil & Refining Co. engineers are using a stored-program computer for completely integrated solutions of complex engineering problems, J. S. Bonner of Humble's Baytown, Tex., refinery, said.

All phases, including necessary assumptions, logic, and adjustment, are under control of the computer, Bonner said. The engineer need only supply the basic data.

When solving a multicomponent distillation plate-to-plate calculation, the original data include only the independent variables necessary to define the problem. The computer makes initial assumptions, if needed, and then, by a series of trial and error calculations, proceeds to a complete solution of the problem, Bonner said.

In the process of this solution, liquid and vapor rates from each plate are calculated by heat balance, tray temperatures are determined by bubble-point calculations, and product compositions are adjusted to secure a feed-plate match. Enthalpy and equilibrium data are evaluated as functions of temperature and concentration.

The answers include over-all material and heat balances, temperature and vapor-rate profiles, and liquid and vapor compositions on every plate. The program is completely general, and will handle "sloppy" separations as well as sharp ones, he said.

An average problem, involving 15 components and 40 stages, requires approximately 1 hour for solution on an I.B.M. Type 650 computer. The same problem would require 150-200 man hours, using a desk calculator, Bonner said.

**Team approach . . .** Shell Oil Co. teams are now using computers for complicated applications which require considerable technical judgment, C. M. Jones of Shell's New York office said.

Team approach is a common characteristic in handling these problems because of the need for more than one technical skill, Jones said. Three examples of this type of application are:

. . . **Location for new refinery warehouse.** This is based upon an analysis of a network of refinery supply distribution, considering types of transportation, frequency of movement, and quantity of types of material needed.

. . . **Economic analysis** of a thermal reforming and blending operation. Basically, the problem is to determine that set of conditions for which the value of the product from the unit, minus blending and TEL expense, is a maximum. Minimum lead requirements and maximum gasoline yields, considering the external effect of available cat-cracked gasoline and straightrun naphtha, are computed.

. . . **Lubricating-plant storage program** based upon operating schedules, feed availability, and market requirements.

**Equilibrium compositions . . .** Computers are being used in process research to find equilibrium composition of products which can be obtained from a given starting material, E. B. Weinberger, Gulf Research & Development Co., Pittsburgh, reported.

The equilibrium composition of any chemical system can be calculated, provided the requisite thermodynamic data are available for all the components at the conditions of interest. However, when more than four or five chemical species are present, the calculations of the complete equilibrium composition may become very tedious and time consuming.

Computers have been used to calculate the equilibrium composition resulting from hydrogenation-dehydrogenation reactions among the $C_6$ hydrocarbons. Some 50 individual hydrocarbons are involved, including representatives of all principal classes.

## Processing

# Two-Stage Cat Cracker Unveiled

MONTREAL.—The two-stage fluid catalytic cracking process of Shell Oil Co. made its official bow to the refining industry here last week.

Its designers claim the new technique gives higher gasoline and lower coke yields and offers greater flexibility.

Dr. J. D. Heldman discussed details of the new integrated unit at Shell's Anacortes refinery in a paper presented at the A.P.I. refining meeting. He also elaborated on points not mentioned in the paper (See page 230 of this issue).

Heldman revealed the process will be available to other refiners. It will be licensed through the M. W. Kellogg Co. of New York and Universal Oil Products Co. of Des Plaines, Ill.

He reported that the Anacortes unit has been operated at a conversion level of 80 per cent plus, with coke yield of 6.3 per cent by weight. At this level of operation, the total 10 R.v.p. gasoline yield including polymer gasoline from cracked gases ran 75 per cent of charge.

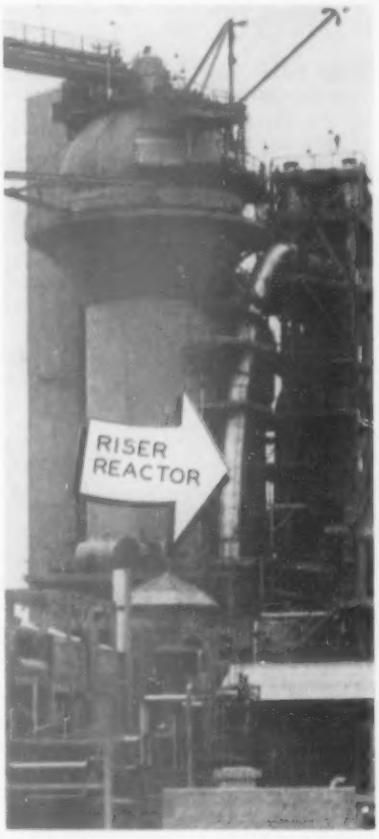
The catalyst, however, shows a rather high metal contamination. Heldman blamed two factors:

. . . **Mixed Alberta feed stock** is fairly high in contaminant metals.

. . . **Catalytic feed stock** represents a deep cut into crude bottoms.

By means of the propane-butane decarbonizing unit at Anacortes it is possible to recover a sizable fraction of heavy gas oil for cat feed. In operation, the bottoms fraction has been reduced to 5 per cent of crude. The depth of the cut can be varied—normally between 5 and 8 per cent bottoms.

Heldman observed, however, that conditions prevailing in the two-stage




**DOMINANT vessel in Shell's two-stage fluid catalytic cracking unit is the regenerator. Curving upward to its right is the riser comprising the first stage reactor. It discharges to a separator which sends vapors into one of two fractionators visible to the left of the regenerator's vertical flue-gas line. Partially spent catalyst from separator is charged directly to the secondary reactor, partly visible in the background.**

system actually reduce the degrees of catalyst contamination by metals in the feed.

**Sensitivity . . .** Gasoline sensitivity is slightly higher in the two-stage system than with a single-stage process.

Pilot plant tests on the same charge showed the following clear octane numbers: Research 93 and motor 82 for single-stage fluid cratalytic cracking; and research 93.5 and motor 81.5 for the Shell two-stage process. This higher sensitivity of about one octane number is due to the higher olefin content of the gasoline from the new process.

The Anacortes unit operated for 83 days before the refinery was shut down by a strike. During the shutdown, the unit has been opened for inspection. It was found to be in exceptionally clean condition, Heldman reported.

## Processing

*If octanes keep rising . . .*

# . . . New Catalysts Necessary

MONTREAL.—Catalyst manufacturers won't be permitted to rest on their laurels.

As refiners go to higher-severity operations in their cat reformers, they require new catalysts which will better meet their needs.

What's being done to meet this challenge was reported here last week by Vladimir Haensel and D. H. Belden of Universal Oil Products Co.

**What takes place . . .** Basic to this effort was a study of the contributions of the various reactions occurring in Platforming.

In processing a simulated straightrun naphtha stock, it was noted that the mere conversion of naphthenes to aromatics produced a relatively small octane-number improvement. Isomerization of paraffins to equilibrium concentration produced a somewhat higher octane number.

The combination of these two reactions upgraded a simulated Mid-Continent naphtha from 31 to about 70 research octane number clear. It gave a $C_5$-plus Platformate yield of 93 per cent by volume.

Additional octanes, Haensel and Belden noted, can be attained by two reaction types.

**. . . Dehydrocyclization,** or conversion of paraffins to aromatics, will give very high octane increases.

**. . . Paraffin hydrocracking** produces higher octanes but only at greatly reduced yields.

In practice, both reactions take place, plus side reactions which further reduce yield.

Attention thus was centered on the conversion of paraffinic materials.

U.O.P.'s studies showed that depending on the composition and method of catalyst preparation, different results could be obtained. Different catalysts responded differently to changes in space velocity and temperature.

Dehydrocyclization is promoted at higher temperature and somewhat lower space velocity. Improved catalysts were found which yielded substantial effects with only small variations in these two operating conditions.

**Poisoning a problem . . .** The work also revealed that catalyst poisoning becomes more serious as operating severity is stepped up. Hence, refiners must take steps to clean up their feed stocks as they go to higher octane operations.

For relatively low octane improvement, catalysts will tolerate substantial amounts of feed-stock impurities. As severity rises, recycle-gas scrubbing becomes necessary to reduce sulfur. At high-octane production levels, feed pretreating by Unifining will become necessary, U.O.P. noted.

Results of this research for future octane operations were reported in the form of new improved Platforming catalysts. The R-5 catalyst in general use is producing high yields of 100-octane fuels with good catalyst life. But the newer R-7 has produced yields several per cent better in some extended tests in commercial units.

As a result many refiners are turning to this improved catalyst. For certain specific applications U.O.P. has another modification called R-8 which will be used soon in commercial operations.

*Refiners handed tips . . .*

# . . . High Octanes at Low Outlay

MONTREAL.—Canadian refiners are boosting their octane potential at a faster rate than the U. S. industry. By the end of this year, they should be on a par from the standpoint of catalytic reforming.

But as Canadian octane ratings rise, dominion refiners will share a common problem with their American neighbors: How best to produce high-octane, premium-grade gasoline.

Some suggestions to refiners in both countries were made here last week by H. R. Grane and J. A. Nevison of Atlantic Refining Co., licensors of the Catforming process.

They reported on studies of various means for making premium-grade fuels at or near the 100-octane level. Three were singled out:

**. . . Thermal reforming** of Catformate plus polymerization of the resulting light olefins. It gives a favorable yield-octane balance.

**. . . Recycling the low-octane fraction** of Catformate through the Catforming unit.

**. . . Separation of Catformate** into high and low-octane fractions for use as selected streams to blend to premium and regular requirements. This does not increase the total octane pool. But it will permit segregation of high antiknock components to meet high premium requirements. The cost also is much less.

Grane and Nevison reported the added investments for recycle reforming or two-stage reforming over conventional Catforming are two to six times as high as the extra investment for fractionating units. Operating costs show about the same great difference.

**Canadian studies . . .** The authors backed up their recommendations with examples from studies made for Canadian refiners. Several blends of Catformate, cat naphtha, and alkylate in the 100-octane range were outlined.

Where the refiner does not have catalytic cracking, isopentane was recommended. A blend of 40 per cent isopentane, 57 per cent Catformate bottoms from Middle East naphtha, and 3 per cent butanes gives a 10-lb. R.v.p. and a leaded research octane number of 101.6.

Where pentane-rich naphthas or field distillate is available, the authors suggested the use of Atlantic's Pentafining process. Costs are low, ranging from $100 to $150 per barrel of capacity. This is exclusive of fractionation which will vary with composition of feed and available facilities. On the same basis, operating costs will run 10 to 15 cents per barrel, they said.

# Cat Reformers Pushed

## Unusual Amoco unit uses six reactors; five keep running constantly while catalyst in sixth is being regenerated

MONTREAL. — Catalytic reformers are being pushed a little harder every month to make higher-octane fuels.

This refining trend was pointed up at the A.P.I. Division of Refining meeting last week by the story of a Gulf Coast unit. It is a 21,200-bbl. per day Ultraformer which has been making 100-octane clear products for more than a year.

P. C. White, W. F. Johnston, and W. J. Montgomery of American Oil Co., Texas City, told how it was done. Their unit has six reactors. Five are arranged in a circle about the sixth, a swing reactor. This greatly simplified piping so the swing reactor can be substituted for any of the five that need regeneration.

The low pressures of 250-300 psi. which are used give better gasoline yields but also increase coke laydown. For this reason, one reactor is regenerated every day on the average.

This has not harmed the catalyst, the Texans said. At this continued high-severity operation, present life is about 20 bbl. per pound after an average of 65 regenerations.

**Troubles . . .** Amoco had its troubles getting the operation lined out, but solved them.

The first problem was a high pressure drop in the reactors—up to 122 psi. against 15 psi. on design. Engineers found that the high velocity of process vapors (150-250 ft. per second) hitting the catalyst beds caused attrition and catalyst dust plugged the beds.

Amoco engineers solved this problem with three steps. The inlet-nozzle distributor was modified. A layer of aluminum balls was placed over the catalyst. This protective layer was kept in place by a series of revetment rings. That solved the catalyst attrition problem.

Then came corrosion troubles. The 400° F. end-point feed contained 250-300 p.p.m. of sulfur. Hot tubes in several reheat furnaces showed up after 1,500 hours of operation, and pressure drops appeared to be rising in reactors.

Inspection showed high-temperature attacks by hydrogen sulfide, a common problem when catalytically reforming sour stocks. Hard scale, formed in furnace tubes and transfer lines, was plugging catalyst beds.

The solution: Hydrodesulfurization of feed stock. For this, Amoco converted its fixed-bed Hydroforming unit to an 18,000-bbl. per day Hydrofining unit.

**Operating data . . .** The unit operates at reactor-inlet temperatures of 900°-970° F. The recycle-gas ratio is 3,000 to 6,000 cu. ft. per bbl. of feed. Space velocity in weight of oil per hour per weight of catalyst is 1 to 4.

Feed runs 33 per cent paraffins, 53 per cent naphthenes, and 14 per cent aromatics. Volumetric yields for two severity levels are:

| | Per cent | |
|---|---|---|
| | 97 O.N. product | 100 O.N. product |
| $C_4$ | 6.6 | 5.4 |
| $C_5$ | 6.5 | 6.1 |
| $C_6$ to 400° F. | 72.2 | 72.9 |
| Polymer | 2.6 | 3.2 |

The 100-octane gasoline runs 22 per cent paraffins, 3 per cent naphthenes, and 75 per cent aromatics.

Amoco reported total direct operating cost for 100-octane operation at about 25 cents per barrel, excluding royalty, depreciation, administration, and overhead. They break down like this:

| | Cents |
|---|---|
| Operating labor (at $2.75 per hour) | 2.8 |
| Laboratory | 1.8 |
| Fuel at 15 cents per M.M.c.f. | 4.7 |
| Power at 0.8 cents per kw.-hr. | 2.7 |
| Steam at 30 cents per 100 lb. | 1.9 |
| Catalyst | 7.1 |
| Maintenance at 3 per cent of investment per year | 2.8 |
| Taxes and insurance at 2 per cent investment per year | 1.8 |
| Total | 25.6 |

On the basis of success at Texas City, Amoco is building a 7,600-bbl. per day Ultraformer at the new Yorktown, Va., refinery. It will also operate at the 100-octane number clear level.

## Instrumentation

# Automation Has a Big Future

MONTREAL. — Refiners have just scratched the surface in automatic control of their plant processes.

Albert F. Sperry of Panellit, Inc., Skokie, Ill., in fact, told members of the A.P.I. Division of Refining here last week present-day refinery operations are not automatic in any sense.

The refinery operator usually has a centralized control board. It is equipped with remote instrumentation, alarms, recorders, and often graphic-panel instrumentation. These supply him with information on which to base his decisions.

But his operation is not automatic because he must:

**. . . Observe** certain operating changes and make adjustments in others.

**. . . Wait hours,** and sometimes shifts, before he gets information from the analytical laboratory.

**It's too slow . . .** The technical staffs in most plants rely largely on information gathered by hand on log sheets.

They receive and complete these data usually once a day, and it's 3 or 4 days to a week before their observations or calculations can be relayed to the operator and thus become effective.

The weakness in the whole situation lies in the difficulty of converting masses of data into information, and doing this in time to make effective corrective action possible, Sperry said.

**Meeting the problems . . .** Refiners are attacking the problem today on two main fronts.

End-product instrumentation will soon eliminate those hours of lag in the operator's operations. His entire time scale will be compressed into seconds, and minutes, where it should be for truly effective control.

Information gathering, or data-reduction systems, provide the means for getting at least part of the required information to the technical staffs in a hurry. However, to meet all the technical needs and the needs of mangement as well, there is only one real alternative, Sperry said. The information system must feed its information to a digital computer used full time in the data-processing systems.

This system can furnish to management, either directly or through its accounting department, a daily report of all quantities that make up costs and yields. And this information is provided in a form so that it is readily convertible into dollars of income and expense, Sperry said.

## *Refiners doubt need of three grades but say . . .*

# . . . 100 Octane to Spread Over the U. S.

CHICAGO. — Midwest refiners are split down the middle on the need for a 100-octane super-premium introduced by Esso Standard Oil Co. in the East and Southeast.

The three-grade marketing plan *(The Oil and Gas Journal, May 7, page 80)* now adopted by Humble Oil & Refining Co. in Texas, has forced a decision upon refiners which they thought was years away. Widely divergent reactions evoked by the move are to the effect that it is:

**. . . A practical solution** to the many-angled octane race.

**. . . An unwarranted burden** on those who refine, market, and transport motor fuels in the Midwest.

There is agreement on but one point concerning Esso's action, which followed the introduction of five grades in Florida by Sun Oil Co. *(The Oil and Gas Journal, February 27, page 82).* That is that it has played havoc with the timetable on 100 octane for all U. S. motorists.

Some refiners had figured the barrier would not be cracked generally before 1960. They felt that auto engines would not require the added octanes until then.

Now most agree that it may be only a matter of weeks or months until motorists over a large part of the country are offered a motor fuel equivalent to aviation specifications early in World War II. It is expected to be in general use in 1 to 2 years.

The question is not whether to go to the high octanes. It's how to do it. And that in turn brings up these alternatives:

**. . . Adding a third grade** as Esso and Humble have done.

**. . . Sticking to two grades.**

**For three grades . . .** For the Esso system there is the argument that a super grade is the answer to meeting requirements of the small percentage of highest-compression engines. Present premium and regular grades would remain satisfactory for the great bulk of motor vehicles with no increase in octanes.

Refiners in this camp contend they would not have to add as much to their octane pools as will be required if the race goes on under the two-grade system.

They also like the price differentials. The 100 octane brings 3 cents above premium and 5 cents above regular. Refiners here, as in all areas, complain that refinery and retail prices have not adequately reflected the added costs of steadily increasing octanes.

**Depression ghost raised . . .** But many are haunted by memories of conditions which prevailed 20 years ago when three grades of gasoline were being marketed.

The third was the cheapest, usually unleaded. It was designed to meet depression competition with no regard for adequate returns to refiners and marketers. Motor oils retailing at 15 cents a quart were companion products to the cheap gasoline.

Some fear a return to these conditions. They predict that the 100 octane will quickly become the only premium. The premium will become the regular grade. And the present regular will fall to the same position as the old third grade of the 1930's.

The lowest grade, these refiners claim, would be used to battle price cutters whose operations are expanding in the Midwest. To cut costs, the octane number of this fuel might be lowered. Such a move, it is felt, would further confuse an already complex situation.

**The storage problem . . .** Most of the prewar service stations in this area which have not been abandoned or rebuilt could be adapted to handling another grade. Because of conditions in the depression, they had separate underground storage for three grades.

But most of the thousands of stations built since World War II, and this includes a large percentage of the superstation type, have storage for only two grades in two tanks. They were designed to take advantage of transport deliveries of 1,000 to 3,000 gal. to save transportation costs over smaller tank-wagon deliveries.

City ordinances present another problem. In many cases the stations which are usually refinery owned or leased now have all the storage permitted at one site. A third grade would mean that underground storage would have to be rearranged and another tank installed with no increase in total capacity.

This would cost at least $3,000 per station for third installations, according to one informed estimate.

**For two grades . . .** Refiners and marketers are also weighing added expenditures and operating costs at bulk stations and pipeline terminals.

With these sizable new outlays in mind, some Midwest refiners, large and small, plan to stay with the two-grade system regardless of what competitors may do.

They reason this way: It will be more economic for them and their jobber and dealer customers to take capital needed for a third grade and spend it on new processing equipment. They could then increase their premium octane to make it competitive, if necessary, with 100-octane fuels. With a like boost in regular, they feel they would be in a sounder quality position than with three grades having a lower over-all average.

**Modified Sun plan . . .** One major company is considering an adaptation of the Sun five-grade system which would not involve added storage.

The 100-octane super premium would be stored in one tank and regular in the other. A mixing device at one or more pumps would blend the two grades to produce the ordinary premium.

Another adaptation of the Sun plan, which entails blending at the hose nozzle, would have no bearing on a super-premium grade. One storage tank would contain the present premium. The other would hold a low-octane material which would compete with products sold by price cutters under the regular grade.

## *Humble to Market Third Grade, Too*

HOUSTON.—Humble Oil & Refining Co. will begin marketing its 100-octane plus Golden Esso Extra gasoline in Texas about June 20.

The new super premium, announced earlier this month by the affiliated Esso Standard Oil Co., is designed for ultrahigh-compression auto engines. It will carry a 3-cent higher tank-wagon price than the premium Esso Extra.

The new third grade will be sold first in Houston, Baytown, Dallas, Fort Worth, San Antonio, and Austin. It will be introduced later to other parts of the state.

The announcement was made by H. W. Ferguson, vice president in charge of refining and marketing for Humble. Carter Oil Co., another Esso affiliate, has not yet disclosed its plans.

Regular could be produced by blending the premium and low-octane material at the pump. Behind this scheme are companies who insist that the industry in this area needs a lower-octane grade to meet low-priced fuels sold in several of the larger cities.

**Processing required** . . . Refiners are divided, too, on what processing units will be needed at refineries which will have a big volume of 100-octane output.

Those in a position to know discuss this point somewhat guardedly. They want to await developments in processing trends not now clearly defined *(The Oil and Gas Journal, March 19, page 186)*.

Most refiners are expanding their catalytic reforming facilities. Some say the solution lies in recent developments which have seen up to 100 octane clear produced in reforming.

More and more refiners are leaning toward alkylation along with whatever isomerization capacity is needed. They contend that the motor-fuel antiknock problem will not necessarily be solved when 100 octane has been made by the research method. The fuel still must measure up in road and other tests.

## Refinery Expanding

### Sarnia plant adding two units for petrochemicals

TORONTO.—Canadian Oil Companies, Ltd., will add a 3,650-bbl. per stream day Udex extraction unit, and a 4,400-bbl. daily Platformer to expand the petrochemical output of its Sarnia refinery.

Construction on the $3-million project is slated to start this fall and both units are expected to go on stream by mid-1957. The new units will be designed, engineered, and licensed by Universal Oil Products Co., Des Plaines, Ill.

The Udex unit will be the first of its kind built in Canada to extract benzene, toluene, and xylene from oil. Announcing construction plans last week, W. Harold Rea, company president, said the production of petrochemicals is becoming "more and more important in the profit potential of a refinery operation."

Rea said the total output of benzene has already been contracted to chemical plants. At least a part of the toluene and xylene will be used by Canadian Oil as gasoline components. An additional 5,000 bbl. daily crude distillation capacity at the company's refinery will go on stream this month raising its total daily throughput to 30,000 bbl.

## watching WASHINGTON

**. . . with Bertram F. Linz**

### Johnson takes dim view on compact probe . . .

THAT all-out probe of the operation of the interstate oil compact planned by the Justice Department may not be made after all.

A very skeptical Senate committee may not grant the $762,000 asked by Atty. Gen. Herbert Brownell. The House approved the fund. But the Senate group, headed by Sen. Lyndon Johnson of Texas, doesn't see the need for a detailed study of the compact.

Brownell plans to hire 110 people and open 2 or 3 offices to make a big production out of what Johnson said was a request merely for a report on the operations of the compact. The report would show whether the member states were living up to the compact's prohibition against its use to limit production to stabilize or fix prices.

The department wants to do a "workmanlike job," Brownell explained. But Johnson suggested it would do a lot better to use more money to inquire into the increase of 1,200 antitrust complaints reported by the antitrust division.

Brownell said he hadn't asked for the job. In this case, Johnson said, he won't be too disappointed if he doesn't get the money. And, the Texan suggested, either the department asked so much it expected to be turned down or it believes a lot of money is needed for a little job.

The department is supposed to report on the compact yearly. It will not make any report this year because it got no money for the study.

### Why we need more highways . . .

CONGRESS was reminded of the need for speed in putting through the new highway building program last week.

Already crowded roads are more congested than ever, the Bureau of Public Roads reported. Today there are over 7 per cent more cars and trucks on the road than a year ago. Registrations last year reached to more than 62,760,000. By the end of this year they may total over 65,000,000.

California alone has more than 6,000,000 cars and trucks. Six other states have more than 3,000,000. All told, 24 states report 1,000,000 or more.

There are now more than twice as many cars, trucks, and buses than there were in 1945, the bureau figured. There will be 92,500,000 of them by 1971, the Commerce Department estimates.

### Minimum-wage issue draws opposition . . .

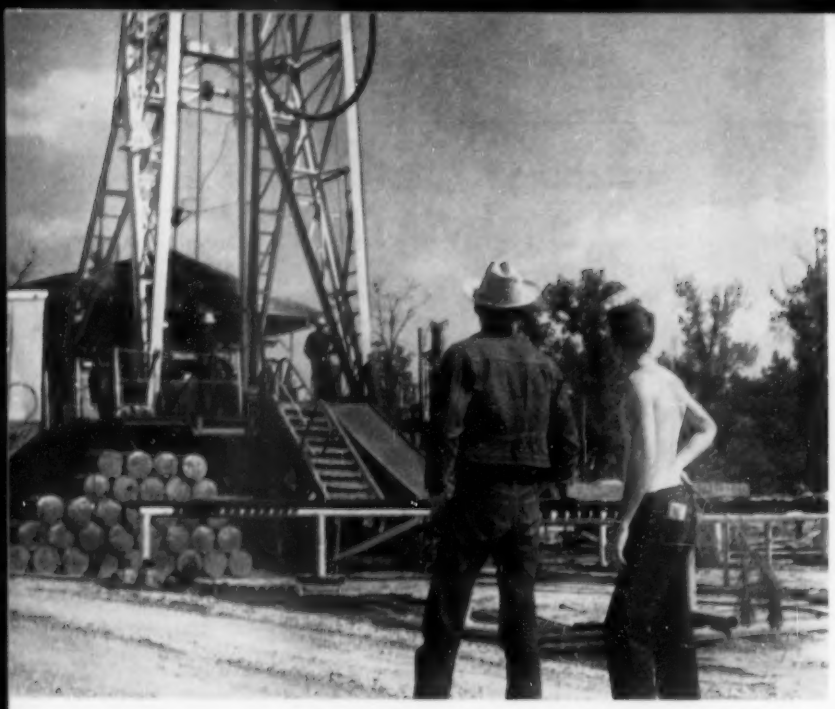
A FIGHT is brewing in Congress over extension of the minimum wage to retail and service workers.

Organized labor is backing the idea. Its spokesmen talk about "forgotten workers" and a "horse-and-buggy economic concept." They are getting a sympathetic hearing from Sen. Paul H. Douglas of Illinois, chairman of a labor subcommittee studying the subject.

Business is against the plan. Its leaders argue that wages for retail workers are close to keeping pace with those in manufacturing. They rose 117 per cent between 1930 and 1950. Industrial pay, mostly covered by the Fair Labor Standards Act, rose 121 per cent.

It's admitted the $1 an hour minimum wage would lead to pay increases. But this, in turn, probably would lead to higher prices to customers and loss of jobs for workers, businessmen warn.

The law could be extended to retail businesses if it is determined they tie in with interstate commerce by handling products made outside their state. But business claims these are basically local operations, even though a single firm may have outlets in two or more states.



## Part 2

**This is the second of two articles on the profit problems of drilling contractors. As the contractors see it, their problems are of two types: Those caused by the oil companies for which they work, and those caused by the contractors themselves.**

**The first article (May 14, page 96) outlined the contractor's company problems—and the companies' replies. In this one, the contractors do a little self-analysis, and they're frank about their own shortcomings.**

**They know their problems. But if there's a solution, it isn't simple and—it isn't in sight.**

*When analyzing their price problems . . .*

# Contractors Find Fault at Home, Too

"WE'RE just cutting each other's throats as fast as we can," says a Houston contractor in summing up what's wrong with the oil-drilling industry.

Most other drilling men also confess much of their trouble lies within their own ranks. All the blame isn't in price-cutting policies of the oil companies *(The Oil and Gas Journal, May 14, page 96).*

The throat cutting may stem from many causes—poor bidding, depressing effect of too many inefficient contractors or noncompetitive rigs, or just sheer panic. At any rate, the contractors and oil company officials agree on one point: It takes a better business man to stay ahead in the drilling business now than ever before.

One old-time Tulsa contractor describes the current situation as "A period of elimination—the men are being separated from the boys." But he adds, "The result of what we see going on now will be fewer contractors and rigs in the future, permitting those left to operate at a profit. However, I don't look for times ever to be as good as they formerly were."

Consensus of drilling contractors is that the drilling business always has had a high rate of bankruptcy. And the tempo may be stepped up this year and next. The majority of concerns will survive. But the margin of profit has been sliced so thin it's touch and go to keep equipment competitive and have enough left to cover emergencies always arising.

Contractors are mercilessly frank in pointing out their own faults. Here's what they say is wrong.

**Poor bidding . . .** "When a contractor gets in a jam, it's his own fault for unwise bidding in 99 per cent of the cases," observes a Dallas drilling official. And this man puts his finger on one of the touchiest problems in the business.

Since low bidding has become such a factor in obtaining drilling business, a contractor has to know what he's about to stay in. Most contractors say cut-throat bidding results from:

**. . . Poor cost accounting** and bad management. "Some fellows with new rigs think they can drill a little cheaper than their competitors. But they're not looking far enough ahead to see what's going to happen to them when that rig wears out," says a Gulf Coast contractor.

"Obsolesence actually costs more than depreciation," a Tulsa reports. "Actually an older rig in good shape may not be competitive and might as well be junked. To compete today, a rig must be light to save on moving costs yet powerful enough to get fast penetration rates. If a contractor is to keep up he has to bid enough to cover depreciation and obsolescence."

"One thing a contractor operating on a shoe string doesn't figure," says another Houston rig owner, "is an emergency. He goes for a profit of $1,000 or $2,000 say on a 10,000-ft. well. But he can't stand the strain when he loses a hole and $50,000 goes down the drain. In order to stay in business over a long stretch you've got to make enough on normal jobs to allow for such losses occasionally."

Other contractors point out poor management practices can make a perfectly good bid go sour. They blame loose control over actual drilling operations, poor habits in buying supplies, not enough attention paid to attracting efficient crew personnel.

**. . . Poor information** based on inadequate investigation. The classic story is told in Texas of the contractor who walked into a company office and said, "I don't care where the well is, I bid $3 a foot."

Instances are legion where it has paid the contractor, however, to be informed before bidding. An Oklahoma contractor says he once was asked by a company to bid on a well at the edge of a field. He had drilled several development wells in the area but refused to bid the going-rate on the edge-of-the-field well.

"I knew that two wells drilled much earlier had run into entirely tougher drilling on that side," he said. "Another contractor took it at the field price

and sure enough he ran into trouble and went broke."

**. . . Panic from an idle rig.** "The big trouble seems to be that when a contractor has a rig idle for a few days he gets panicky," a Texan reports. "So he cuts his price two-bits a foot to make sure his rigs are kept working."

Another observes, "it would be better for us to let a rig stand idle a little longer than take an unprofitable job."

"The fellow with production isn't worried so much about a rig being idle for a while. His other income will tide him over. He's not the one who cuts prices. It's the independent contractor who gets jittery too easily."

**. . . Poor estimate on drilling time.** "Too many contractors are missing their estimated footage time by as much as 2 days," a prominent Tulsa official reports.

"We're over-optimistic about increasing the rates of penetration. We've been able to profit by this in the past. So we bid the best time in an area. Maybe we can equal it, but we've nearly exhausted our means to better it. So that gives us no margin for trouble."

Another contractor added, "We've overextended the capacity of our rigs in estimating depth and penetration rate. We have left no margin for hazard."

"This faster drilling pattern of thinking has produced unrealistic prices based on half facts and long hopes," another contract company official states. "In faster drilling, we have forgotten to consider that our prices also must cover more moving costs, more down time for rigging up and tearing down."

**Better organization . . .** Many contractors think everyone is too secretive about vital information in the business. Others criticize activities of their trade organization. They think it needs to tackle more practical problems.

On the score of keeping operating information secret, one contractor noted: "Each could profit some from someone else's experience. But we're too independent. If one fellow loses his shirt in a deal, he doesn't want it known. He feels the same if he makes a pile. The result: One contractor sees another drilling at a low price, figures he can do it too. What he doesn't know is the first guy is losing money on the job."

One critic of the drilling industry advocated a stronger organization for contractors. "There's no more association among contractors than there is among bootblacks," he added.

"When you attend a meeting, you're just sitting there wondering how you can underbid the other fellow. I think our present association can do something about it if it will stop messing around with unessentials and try to get the price corrected."

**Too many in business . . .** Most contractors believe an over-supply of rigs and contractors is depressing the business.

Their criticisms cover a wide field, including:

**. . . Old-time contractors,** now outdated. "Some of those so-called oldtimers have never been true contractors," a Dallas contractor said. "They always used patched-up equipment, horsed a hole down any old way, and didn't know the meaning of cost accounting. Many of this type manage to stay alive because they have some oil production. The only work they can get involves some sort of drilling deal. You never see them working for the majors."

Another observed, "Some operators who for years had 'an umbrella held over them' by a major have gone out of business as the umbrella was removed. They found they couldn't compete with their equipment."

"The average old contractor doesn't have enough modern equipment," a Texan claimed. "Some don't go in for slim-hole drilling, for example. Contractors are notoriously slow to accept new equipment and methods. In fact, contractors are the worst enemy a contractor's got."

**. . . Shoestring operators.** "There are too many men in the contracting business who don't know anything about drilling or the oil business," one man commented in Houston. "They get promoted into buying a rig, don't have enough operating capital, and work for any price to meet the mortgage payments."

One Tulsa contractor traced trouble in the industry to the time when bankers, ranchers, doctors, and businessmen in West Texas jumped into the contracting business during the Spraberry boom several years ago.

**. . . Speculators and dealers.** "Speculators tend to increase price cutting. Some little outfits get into business by selling speculative stock. Then they cut footage rates for an interest in any production developed."

Some contractors also claimed many rig owners actually are speculators or promoters and not contractors in the true sense. "They keep a rig or two just to be able to take advantage of deals or farmouts from the majors," one contractor reported. "Their drilling operations are secondary to the production they are hunting. They don't care anything about conditions in the contract-drilling business."

Many contractors report they believe promoters are responsible for the upward trend recently in the number of turnkey drilling jobs. The idea of turnkey contracts was advanced about a year ago as one method of boosting the contractors' income. But some said it hasn't actually worked out that way.

Under a turnkey contract, the contractor does all the work on the well from staking it to running oil into tanks—if it's a producer. Contractors report there are many pitfalls in this type of job. The risks are greater. It takes more financing. It's hard to realize enough extra from the subcontracts for well servicing to cover the extra overhead caused.

A few of the larger contracting firms are set up to handle this kind of work. They frankly admit they don't encourage too much of it and are certain when they take such a job to figure in a safety margin for emergencies.

**Who's making money . . .** "Things, however, aren't so bad off that a capable contractor can't still make a decent profit," says a Dallas official.

Many others express confidence they at least can ride through present rough conditions. Some say "the contractor almost has to have production to stay in business" and they are looking for oil deals.

Apparently the ability to make a profit doesn't depend on size of the drilling outfit. Some one and two-rig operators were cited as making handsome returns while larger concerns were reported fighting to keep in the black. Profits, according to the contractors, depend on several factors:

**. . . Good equipment.** This means not only modern but competitive for the particular area it is being operated. Two successful Denver contractors reported, for instance, they had found their newest, heavy rigs weren't making money in the Rockies but some of their modified slim-hole equipment was doing well. So they are moving their big rigs to Canada where they can compete better.

**. . . Low overhead.** A small contractor may hold a big edge over his larger competitor on this score, allowing him to work cheaper or show larger net returns.

**. . . Experienced personnel.** Capable drilling superintendents, toolpushers, and rig crews can make or break a contractor. Many contractors and some company officials express concern that the drilling industry is not attracting enough young men. They say this can spell serious trouble in the future.

**. . . Ability to change gears quickly.**

This may mean moving into a new area early while the drilling is good, adopting a new process, or adding a revolutionary piece of equipment.

One contractor said his method of operating was to skim the cream off the business in an area and then when too many rigs crowd the field move to a new area. His rigs were moved in early at such widely scattered regions as West Texas, the Rockies, and Canada. He now is investigating possibilities of foreign drilling.

Another owner of a small size outfit says he is making a profit by using far different methods. He keeps his rigs operating in the same area. He doesn't want to get more rigs than he personally can supervise and takes advantage of short moves and greater crew efficiency from drilling the same formation.

. . . **Luck** — something everyone in the risky drilling game can use.

The contractors say that any outfit making money now must combine all or most of these factors in its setup. Some believe other factors also contributing to a successful operation are good source of financing and tight management, including good cost control and accurate bidding.

**What's needed?** . . . The prescription contractors recommend for curing the ailing industry would have these ingredients:

. . . **New outlook** for company management. Policy of a fair profit for contractors would help. Standard equipment requirements and a more uniform drilling contract also are cited as needs.

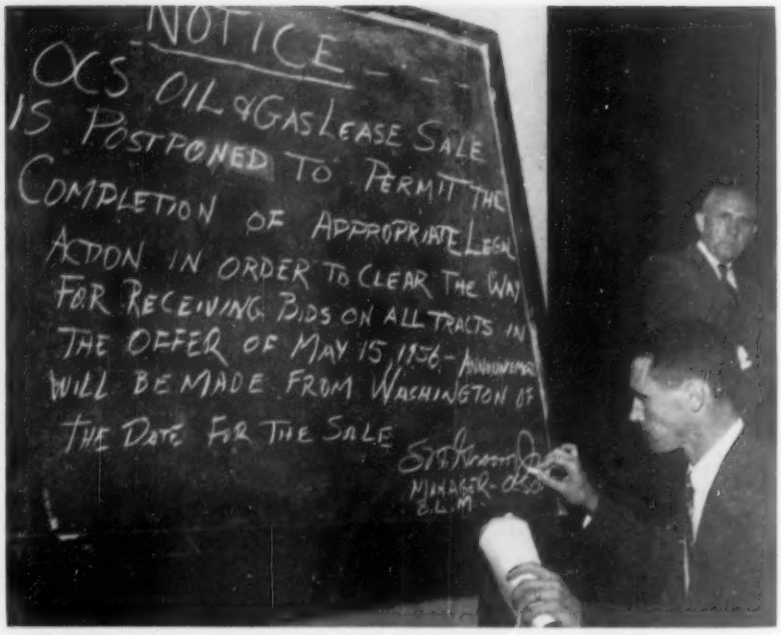
. . . **Better bidding** more accurately to reflect costs, depreciation, obsolescence, and fair profit margin.

. . . **Tighter management** to lower costs, to train crews better, and spend more on research for improved drilling methods.

. . . **New financing concept**. Bankers should be persuaded that equipment is a bankable item as well as production, and supply companies should be shown that more careful credit policies for rigs might help the entire industry.

. . . **Real cooperation** between contractors and companies and contractors themselves. Some contractors advocate a responsible spokesman for their industry who could carry their story to top management. Others think their present organization also should concentrate on a campaign to improve the footage price situation.

But all contractors agree their big need is a common one for the entire domestic oil industry: Some really big new oil fields and higher crude price.


NOTICE - - -
OCS OIL & GAS LEASE SALE
IS POSTPONED TO PERMIT THE
COMPLETION OF APPROPRIATE LEGAL
ACTION IN ORDER TO CLEAR THE WAY
FOR RECEIVING BIDS ON ALL TRACTS IN
THE OFFER OF MAY 15 1956 - ANNOUNCEMENT
WILL BE MADE FROM WASHINGTON OF
THE DATE FOR THE SALE

**OFFSHORE SALE CALLED OFF by the Government after Louisiana court order. Posting the notice is Sidney M. Groom, Jr., manager of the outer Continental Shelf office, U. S. Bureau of Land Management. Looking on is H. C. Teasdel, president, The California Co.**

# Offshore Sale Delayed

## Interior Department postpones leasing as Louisiana wins first-round court decision over the disputed 'twilight zone'

NEW ORLEANS.—Submitting to a Louisiana District Court order, the U. S. Department of Interior last week indefinitely postponed the sale of oil and gas leases on more than 500,000 acres under the Gulf of Mexico.

A dramatic legal skirmish gave Louisiana one of its greatest victories to date in the bitter feud between the state and federal Government over ownership of disputed tidelands.

The climax came on the same day that Earl K. Long, Fiery 60-year-old that Earl K. Long, fiery 60-year-old emerged from relative obscurity to begin his third term as governor of Louisiana.

The order by soft-spoken State District Judge Mark C. Pickrel of Lake Charles accomplished—for the moment, at least—what harsh words and frequent threats had failed to do in the past.

Stunned by the unexpected temporary restraining order, Interior Department officials not only withdrew their offering of some 355,000 acres protested by Louisiana, they also delayed the leasing of an additional 160,000 acres outside the disputed area. This included 23,000 acres off the Texas coast.

Word of the cancellation came from Washington as approximately 100 oil-company representatives were gathering at the St. Charles Hotel here to submit bids.

The proposed sale, which might have brought the Government $100,000,000 or more in bonuses, would have been the Interior Department's fourth auction of offshore leases.

The earlier sales netted the Government more than $250,000,000, in addition to one-sixth royalty.

Sidney M. Groom, Jr., manager of the Bureau of Land Management's outer Continental Shelf office, said the Interior Department's next step will be announced in Washington.

Readvertising for bids would require at least a month if legal clearance for another sale were granted at once.

**Issues involved** . . . The dispute over ownership of the Louisiana tidelands is now before the U. S. Supreme Court.

Two basic issues are involved. The state claims its jurisdiction extends 3 leagues (about 10.5 miles) from shore, while the Interior Department contends the boundary should be 3 miles from shore.

The second issue involves location of the shore line. In a 1954 state law,

the shore line is defined so as to give Louisiana a claim to submerged lands as far as 35 miles from dry land.

Last year, just before the federal Government's previous offshore lease sale, the state threatened legal action against any companies moving rigs to offshore acreage involved in the dispute. But this failed to halt the sale. The Government raked in millions of dollars in bonuses while the state failed to get a single bid on 29 tracts which were offered simultaneously by both agencies.

So it was with obvious disbelief that last week's cancellation notice was read by many oil men here for the sale. Under their arms they held briefcases presumably containing checks for millions of dollars.

Until late Monday—the night before the proposed sale—Interior officials were talking of appealing the controversial order in an effort to get last-minute relief. Notice of postponement came from Washington about 9 a.m. Tuesday, an hour before the bids were to be accepted.

**Offensive sudden . . .** Louisiana's legal offensive opened with devastating suddenness just 4 days before the scheduled date of the sale.

Atty. Gen. Fred S. LeBlanc, along with Atty. Gen.-elect Jack P. F. Gremillion, filed for the temporary restraining order against 25 companies which had bid in previous sales and against two Interior officials—Groom and Edward Woozley, director of the Bureau of Land Management.

Judge Pickrel issued the order immediately, preventing the 25 companies from bidding and prohibiting leasing of disputed areas by the individual defendants or by any other person acting "through or under them."

Hearing of the case was set for May 16—1 day after the sale was to be held.

Oil companies then went into federal court. Attorneys for Sun Oil Co. and Pure Oil Co. contended that Judge Pickrel's order placed the 25 companies at an unfair disadvantage because they had bid in previous sales. They pointed out that other companies still would be free to compete.

Federal District Judge Edwin F. Hunter, Lake Charles, amended the order to permit the 25 oil companies to bid. But Groom and Woozley still were restrained from opening the bids.

Companies named in the suit are Anderson-Prichard Oil Corp., The California "Oil" Co., Continental Oil Co. Cities Service Production Co., Atlantic Refining Co., Tidewater Oil Co., Forest Oil Corp., Gulf Refining Co., Humble Oil & Refining Co., Hunt Oil Co., Kerr-McGee Oil Industries, Inc.

**JUDGE PICKREL**
**. . . An Offshore Surprise**

Magnolia Petroleum Co., Ohio Oil Co., Pan American Production Co., Phillips Offshore Oil Co., Placid Oil Co., Pure Oil Co., Seaboard Oil Co., Shell Oil Co., Sinclair Oil & Gas Co., Stanolind Oil & Gas Co., Superior Oil Co., Sun Oil Co., The Texas Co., and Union Oil Co. of California.

**Supreme Court next . . .** At week's end it appeared Louisiana had successfully postponed any further leasing within 3 leagues of its shore until the Supreme Court has acted on the ownership dispute.

Other effects of the postponement may be far-reaching. One landman representing a major offshore operator remarked that the delay might cause competing companies to "come to their senses." He estimated that bidding in future sales may be lower as potential of the submerged oil province is more fully explored.

Some would-be bidders felt, however, that the cancellation may spur competition even further.

Since checks had been written for the required 20 per cent of bonuses offered, some companies representatives expressed the fear that "security leaks" will tip off other companies on their appraisals of certain tracts.

# U. S. Won't Get Russian Drill

WASHINGTON.—The Commerce Department has blocked the deal whereby Dresser Industries, Inc., Dallas, was to obtain the Russian turbodrill in exchange for data on manufacture of American-type rock bits.

Dresser had arranged to buy 40 of the Russian drills with a view to manufacturing them here, provided it could obtain a U. S. license to export technical data requested by the Russians *(The Oil and Gas Journal, March 12, page 87)*.

In Dallas, Dresser officials said the requested license would not give the Russians anything they do not have already, but that the firm will comply with the decision. They indicated that Dresser will continue its own efforts to develop a turbodrill.

**Security involved . . .** Commerce Secretary Sinclair Weeks said that his decision had been reached only after weeks of study by government technicians and an interdepartmental committee. In the course of this study, he added, advice and information was asked and secured from segments of the oil industry.

"We rejected this application primarily because we wish to avoid any action which might serve to weaken the voluntary system of international strategic controls," Weeks said.

The industrial nations of the free world act jointly on a program designed to prevent the Communist countries from securing strategic materials and commodities and technical data that would add to their military power. The arrangement is provided for by the Mutual Defense Assistance Control (Battle) Act of 1951.

Stringent controls are kept on the shipment of oil-production and refining equipment and other goods and technical data which have strategic significance to our national security, the secretary pointed out.

"Under our national policy, no exception can be made unless a net security advantage to the free world can be clearly demonstrated," he said. "The proposed exchange in technical data is not justified within this policy."

Weeks said the data Dresser asked to export cover the latest improvements in oil-well drilling technology in the free world and are among the items which the U. S. and 14 other western countries class as highly important to their security.

Rejection of the export application does not prevent Dresser from securing the technical data or prototypes of the Russian turbodrill "if that could be arranged in a way which would not reveal U. S. technology of a high-security character and would not otherwise be contrary to national policy," Commerce officials said.

# Imports Timetable Set

## Flemming gives importing firms until September 1 to make voluntary controls work; if they fail, president may act

WASHINGTON. — The Government last week set a September 1 deadline on the voluntary effort to control oil imports.

If Middle East oil at that time threatens to impair national security, the protective clause of the Trade Agreements Act will be invoked, Mobilization Director Arthur S. Flemming warned.

That would mean a public hearing sometime during September. It would determine whether presidential action is needed to bring imports closer to the recommendations of the cabinet fuels committee, Flemming said.

To give a more definite picture of the conflict between Middle East and domestic oil, however, Flemming is narrowing the area of comparison. Imports into District 5 (the West Coast) and foreign oil for ships' bunkers and for military use will be excluded, as well as imports from Canada and Venezuela *(The Oil and Gas Journal, May 14, page 100)*.

The cabinet committee will make a new study of the import situation on the basis of the stripped-down figures sometime in the next 3 months. It is expected to report its findings by the September 1 deadline.

**Imports reviewed . . .** Flemming revealed his plans in a letter to the importing companies. He sent them also a staff review of the course of imports over the past year.

The residual-fuel situation is well in hand, Flemming told the importers. Planned imports for the first half of this year, exclusive of fuel for ships' bunkers and for military use, will be only 5,000 bbl. daily above the cabinet committee's recommendation.

Adjustments in crude imports during the first quarter by most importing companies brought actual receipts below original plans, Flemming said. They are "a source of real satisfaction," he added.

Import plans for the present quarter, however, are "a source of real concern." If carried out they would result in an over-all excess for the first half of the year which will "not only offset the satisfactory conditions indicated earlier in the year but will nullify the efforts of a majority of importing companies to conform" with the government's recommendations.

Flemming did not indicate how far imports would have to be cut to meet his program. But he called for cuts that would bring imports for the year as a whole into satisfactory relationship to domestic output.

**Mobilization Director Flemming ... voices another threat to importers**

Actual imports into Districts 1-4 during the first quarter, excluding oil from Canada and Venezuela, were 273,000 bbl. daily. The staff review showed this was 17,000 bbl. daily below the 290,000 bbl. indicated by the cabinet formula.

Imports planned for the current quarter total 352,000 bbl. daily. They would bring the average for the first half of 1956 to 313,000 bbl. daily, or 26,000 bbl. above the 287,000 given by the formula. But this excess, the staff said, would amount to less than 0.5 per cent of the crude supply in the four districts.

The net cut in Middle East imports between November and April was more than 8 per cent of the amount originally planned.

"Most of the reporting companies showed significant downward adjustments in their import programs," the review commented. "Some companies, however, have planned imports for the second quarter of 1955 in such amount as to more than offset the progress made by the industry during the first quarter in the direction of conformity to the advisory committee recommendation."

Imports of residual this quarter will be 325,000 bbl. daily. This would be 23,000 bbl. above the allowable under the formula on an annual basis. But the seasonal shift in demand makes a 6-month comparison more realistic, the staff report said. On that basis the excess will be only 5,000 bbl. a day.

California is being taken out of the picture because there is no present sign of an increase in production there, Flemming said. But if West Coast imports threaten to impair the national security, the cabinet committee will make special recommendations for District 5.

The committee also will watch imports from Canada and Venezuela.

# Ruling Clears Deal

## Atlantic given favorable oil-payment tax decision

WASHINGTON.—The Internal Revenue Service apparently has cleared the way for closing the $224,654,265 deal in which Atlantic Refining Co. will buy Houston Oil Co. and Houston Pipe Line Co.

Atlantic officials in Philadelphia disclosed they had received a favorable tax ruling on aspects of oil payments involved in the deal. Final closing of the deal is expected next month. Houston stockholders already have approved the proposal *(The Oil and Gas Journal, May 7, page 82)*.

The sale involves payment for the properties by Atlantic out of production. It is understood present owners of the Houston companies will receive 85 per cent of the production for a period of about 10 years.

Revenue service officials declined to disclose details of their ruling requested by Atlantic. Federal law prohibits disclosure of matters pertaining to a single company or individual.

The IRS, however, is understood to have held, in line with previous policy, that if the 15 per cent of production retained by Atlantic is sufficient to cover operating costs, they can be deducted as expenses. But if the operation results in a loss, this loss must be capitalized.

Tax treatment of properties purchased in this way has been a big problem to both oil operators and the Government. An IRS spokesman pointed out that in some deals payments out of production run as high as 95 per cent. Since the buyers cannot operate the properties on the remaining 5 per cent, they have sought to include the excess expense with the intangible drilling and development costs on other properties.

The Atlantic ruling would indicate that properties purchased on the production-payment plan are to be segregated and required to stand on their own feet.

# Pipeline Vote Due Soon

## Parliament considered certain to pass Trans-Canada loan permitting construction on the gas line to start July 1

OTTAWA.—The Canadian Government last week invoked closure to prevent the Trans-Canada pipeline loan from being talked to death in the House of Commons.

Trade Minister C. D. Howe used the powerful procedural weapon to limit debate for the first time in 24 years. It brought down the wrath of Conservative and CCF parties upon the minister in what Canadians are calling "the debate of the decade."

Howe's move was the answer to a threat to filibuster past the June 7 deadline for approval of the $72-million loan to Trans-Canada Pipe Lines, Ltd. The government is to lend up to 90 per cent of the construction cost on the 575-mile Alberta-Winnipeg leg of the natural-gas line.

Howe will be able to force the government-sponsored bill to a vote by invoking closure at key points in the debate. And the Liberals, who are backing Howe, have better than a two-to-one majority in Commons. Passage is considered almost a certainty. This means Trans-Canada should be able to start construction by the July 1 target date, complete the prairie section, and start delivering gas to Winnipeg this year, as the bill requires. Failure to complete it this year will cause Trans-Canada to forfeit the line.

**Opposition . . .** Conservatives and CCF members oppose the Trans-Canada corporate structure, charging the company is 83 per cent owned by U. S. interests.

The Conservatives want the line built by Canadian capital—which has not been offered. CCF insists that the 2,250-mile all-Canadian line, extending from Alberta gas fields to Montreal, should be a 100 per cent public venture. Both accuse the government of "selling out to private U. S. buccaneers."

**For Trans-Canada . . .** Howe is going along with Trans-Canada as the quickest way to get the huge project under way after years of struggling.

He points out that Trans-Canada has the:

**. . . Pipe.** The required 34-in. is already being stockpiled by the pipeline company. The government probably could not get any for 2 years.

**. . . Permits.** Alberta and the federal government have approved export of gas to the United States. This agreement with a Tennessee Gas Transmission Co. affiliate is now being debated before the Federal Power Commission.

**. . . Know-how.** Trans-Canada's executive vice president and general manager is Charles Coates, who had considerable experience with T.G.T. before joining the company 2 years ago.

**. . . Right of way and engineering.** Trans-Canada has 5 years' work and some $24 million already invested in the project.

# Navajos Make Deal

## Other operators protest Delhi-Taylor concession

ALBUQUERQUE.—A "foreign-type concession" has been signed between Delhi-Taylor Oil Corp., Dallas, and the Navajo Indian tribe for exploration and development of about 5,000,000 acres in the Black Mesa basin of northeastern Arizona.

The contract must be approved by the Commissioner of Indian Affairs in Washington. It is being protested by the Rocky Mountain Oil and Gas Association on the ground that it may freeze out other operators who have done exploration work on the Navajo reservation.

Apparently the exact acreage to be assigned to Delhi-Taylor has not been selected. A tribal spokesman said the contract involves only lands on which there has been little or no activity and which do not offset present producing properties or those leased to other companies.

Under the contract, the Navajos will furnish the land and Delhi-Taylor the capital, personnel, and equipment. Profits will be split 50-50, with the tribe being a working-interest partner.

Normally Indian lands have been developed by conventional leases, with the tribe getting a 12½ per cent royalty. Delhi-Taylor agrees to employ Navajos wherever possible, and to turn over to the tribe any water discovered and not needed for drilling operations.

## Big Gas Line Nears Finish

RAWLINS. — Construction of the final leg of Colorado Interstate Gas Co.'s 374-mile natural-gas line from Denver to Rock Springs, Wyo., will begin in mid-June.

R. H. Fulton, of Dodge City, Kans., is contractor on the segment, which will connect Rawlins and Laramie, Wyo. Work on the Green River-to-Rawlins portion was begun by Fulton crews May 1, and both segments are scheduled for completion in November. A Denver-Laramie leg was finished last year.

The $29-million, 22-in. Colorado Interstate project ties in at Green River with Pacific Northwest Pipeline Corp.'s line.

# FPC Grants Review

## Ruling halting gas sale for boiler fuel appealed

WASHINGTON.—The Federal Power Commission will review its "Black Dog" decision that a sale of natural gas for power generation may be barred for conservation reasons.

The March 16 decision that Northern Natural Gas Co. should not sell gas on an interruptible basis to the Block Dog station of Northern States Power Co. was challenged last month. Northern Natural asked the FPC for a rehearing, which has been granted.

The boiler-fuel sale was turned down by an FPC examiner on the ground it was a wasteful use of gas. His decision was affirmed by the full commission *(The Oil and Gas Journal, March 26, page 76)*.

The decision was not a clear-cut disposal of the issue, however. Commissioners Claude L. Draper and William R. Connole adopted the conservation theory. Seaborn L. Digby and Frederick Stueck rejected it.

The deciding vote was cast by Chairman Jerome R. Kuykendall. Without accepting the conservation theory, he said he went along with Draper and Connole because it was not shown that the revenue from the boiler-fuel sale would be sufficient to cover the costs.

## Penn Grade Crude Up Again

BRADFORD.—The third increase of the year for Pennsylvania Grade crude prices was posted May 16.

Joseph Seep Purchasing Agency of South Penn Oil Co. raised postings 25 cents per barrel in its area. The new prices are $4.45 for Bradford District oil, $4.32 for Middle District, $4.03 for Southwest Pennsylvania, and $3.91 for West Virginia.

Other purchasers raised Buckeye crude 25 cents to $3.85 and Zanesville 8 cents to $3.10

The increase resulted from heavy demand by refiners and smaller supply from producers' runs causing a continued draft on crude stocks. It was the eighth advance in the upward trend for Penn Grade prices that started in the fall of 1954. Bradford crude during that time has gone up $1.22 a barrel.

**PIPELINERS got plenty of tips on new developments at the panel session of the annual A.P.I. pipeline conference in Houston. J. W. DeGroot of Tuscarora Pipe Line Co., Ltd., Harrisburg, Pa., shown at microphone, was chairman of the program committee. Part of the panel, shown from left to right, includes S. S. Smith, New York consultant; D. L. Rankin, Wyco Pipe Line Co., Denver; L. S. Wrightsman, Humble Pipe Line Co., Houston; and Stanley L. Westlake, Magnolia Pipe Line Co., Dallas.**

# Swing to Meters Starts

## Humble plans to replace hand gaging in measuring lease production into pipelines; others are studying the switch

HOUSTON.—Crude-oil pipelines are fast moving toward volume measurement by positive displacement meters. Many signs pointed up this trend last week at the seventh annual A.P.I. pipeline conference.

Pipeline representatives evidenced extreme interest in two developments disclosed during the sessions:

. . . **Humble Pipe Line Co.** in the next 30 days says it will ask the Texas Railroad Commission for official permission to use positive displacement meters. They will replace hand gages in measuring lease production into a pipeline.

. . . **Interstate Oil Pipe Line Co.** reveals it has a new prover tank for high-capacity meter installations.

**Innovation . . .** Humble reports it has been using meters on trunkline interchange for the last 6 months. The interchange is with a company not affiliated with Humble.

This is the first such use of meters reported from crude-oil pipeline companies. The results are said to be excellent and Humble plans to make the arrangement permanent.

Many other crude-oil pipeliners reported privately their companies either now are putting in meters for tests or have them under consideration. They indicated high interest in results of Humble's tests.

These tests have been conducted for several years in three locations. They have proved that metering is equal to hand gaging or ground-level gaging where no wax is present. It is far better if there is any possibility of wax incrustation on lease-tank walls. This factor alone will warrant meters in some producing areas.

In one test location, wax buildup on lease tanks was unnoticed until metered volumes differed from gaged amounts. Throughout the tests over 1,500,000 bbl. have been metered and hand gaged for comparison. The difference totaled about 0.015 per cent.

Humble says at present it will not propose any automatic custody transfer—only the measurement of volume by meter instead of gaging.

**New meter prover . . .** Interstate also attracted interest when it gave details of its new prover tank for calibrating high-capacity meters.

The scheme uses a 400-bbl. tank and a vertical joint of 26-in. pipe alongside of it. The big tank has upper and lower weirs. It is connected to the vertical pipe by a spillover line at top and a valved connection at bottom. Sight glasses for measuring levels are installed on both the large tank and the vertical pipe.

In use, the big tank is filled slightly above the top weir and the input line shut off as quickly as possible. Spillover into the vertical pipe is measured and added to the big tank volume. When filling starts, the fluid level is even with the big tank's bottom weir.

The tank serves the same purpose as a conventional prover tank with "necked-down" sections at top and bottom. But it is said to be cheaper. The large size of the tank (common sizes of provers range up to 20 bbl.) greatly reduces the margin of error in meter calibration. Calibration time for a meter with the tank is about 30 minutes.

The tank is in use near Baton Rouge where Interstate delivers over 300,000 bbl. daily to the Esso refinery. Custody transfer is entirely by meter. All accounting is based on meter tickets. No gaging is done.

**New look at problem . . .** One prominent products-pipeline consultant advised crude-oil people to back off and take a new look at the problem of automatic custody transfer.

He said the industry is making a mistake in trying exactly to duplicate with instrumentation the functions of a human gager.

Instead, he said the problem should be considered as an entirely new one. Quality control, quantity measurement, and dispatching should be kept as separate functions. Then all the pipeline must be concerned with is net volume, gravity, and scheduling.

Others in the panel discussion meeting who have pioneered in automatic-custody transfer work did not agree the problem was so simple. The primary concern still is with the accurate measurement of b.s. and w. and with methods of assuring that bad oil will not enter the line.

## Oregon Refinery Studied

SEATTLE.—Refining representatives of Richfield Oil Corp. have completed an inspection of the Pacific Northwest with a view "to possible construction in the future."

A Richfield spokesman said the company is not planning to build a refinery in the area at the present. However, it has been reported Richfield has been negotiating with the Tulalip Indians for a site in Oregon. It also has been reported a representative of the Indians is scheduled to confer with the Bureau of Indian Affairs late this month in Washington over possible sale of the land to Richfield.

# Electronic Dispatching Near

## But computers won't eliminate all the human factors in products-pipeline scheduling, Great Lakes study shows

HOUSTON. — Electronic computers soon may go to work for product-pipeline dispatchers. Schedules that now take days to prepare manually will be dashed off in hours.

That's encouraging news from a 4-year research program undertaken by Great Lakes Pipe Line Co. Results of the study were revealed at the annual A.P.I. pipeline conference here last week. It was the first joint meeting of both crude and products pipeliners.

One big problem previously has plagued use of computers in pipeline scheduling. The scheduling cannot be expressed as a strict mathematical equation. If it could, any dime-store computer could be used. But scheduling involves mathematics, logic, and common sense. No one has built common sense into a computer.

Fayman said this means the human factor won't be eliminated from pipeline dispatching for some time to come —if ever.

**What machine does . . .** The computer now rented by Great Lakes will be programmed to duplicate digitally the physical pipeline system.

It will simulate lines, tanks, terminals, etc. The machine thus will do most work for a good human scheduler. It will make routine decisions to keep all shippers supplied with the proper product at the right terminal. Major job of the computer will be preparation each day of a schedule for the next 28 days' operation.

Then, when unexpected product demand or an unusual line condition develops, the complete schedule can be reworked in a few hours. Normally, such a situation brings feverish activity in the dispatcher's office and requires many manhours of work. The computer should mean greater line efficiency and better customer service.

The computer will cost Great Lakes an annual rental of $86,000. It will be large enough to simulate the entire pipeline with room for an expansion of the system. The machine at first will be devoted entirely to scheduling. But later it may be used for engineering and accounting problems.

**Bad pumps run fever . . .** Phillips Pipe Line Co. jolted the pipeliners with a revelation in an entirely different area. It has devised a means of checking efficiency of a pump through temperature rise of the pumped fluid.

G. J. Jennings of Phillips reported the method is cheap and simple. It has been proved accurate through many tests.

Knowing the efficiency of a pipeline pump is important to operators. Previously there was no way to measure this efficiency directly without including the pump's prime mover. This means input to the motor or engine can be measured and hydraulic output of the pump can be measured. But the two measurements must be taken together, and there has been no way to separate losses.

Phillips' approach isn't just one of measuring input and outgoing temperature. Corrections must be made for heat increase of any fluid placed under pressure. But the amount of correction can be predicted. Phillips tested eight different-weight oils. Temperature rise for each was found to be a straight line function of the pressure.

Final formula presented by Jennings for calculating pump efficiency by temperature rise involved only pressure and temperature differentials and correction factors for specific heat and for gravity. There is no flow factor involved. Jennings said this is fortunate since the exact rate of flow at the time of test often is difficult to determine.

Hardest part of the method, according to Jennings, is in making good temperature measurements. He suggested using thermometers which can be read to the nearest 0.05° F. He said error of the method would be no more than 1 per cent.

## FPC Approves Gas Reservoir

WASHINGTON. — Development of an 8.5 trillion cubic foot underground gas storage area in western New York was approved last week by the Federal Power Commission.

The storage is planned by Iroquois Gas Corp. of Buffalo. A former gas producing reservoir 3,000 ft. deep will be used. Provision will be made for a maximum withdrawal of 80,000,000 cu. ft. per day.

The FPC approved Iroquois' plan to build 14 miles of delivery pipeline, 22 miles of gathering line, drill 16 wells, and reclaim or recondition 64 existing wells. A 900-hp. compressor station will move gas from the Nashville storage area to the company's mains. Cost is placed at $2,877,200.

## *Refining* BRIEFS

**WARREN, Pa. — United Refining** Co. has let contracts for over $2 million in new equipment at its refinery here to Procon, Inc., Des Plaines, Ill. Additions will include a 2,500-bbl. fluid cat cracking unit and gas-recovery facilities, a catalytic polymerization unit, and light hydrocarbon and gasoline treating equipment. Work will begin in June. Completion is expected by early winter.

**BILLINGS, Mont.—Farmers Union** Central Exchange, Inc., has added 2,000 bbl. a day to the crude capacity of its refinery here. The addition boosts total capacity to 18,000 bbl. daily. New facilities include a petrochem heater, six new process pumps, and a new prefractionator condenser.

**CHARLESTON, W. Va.—A 1,000-**bbl. Unifining unit, designed to operate with a Platformer, has gone on stream at the Elk Refining Co.'s Falling Rock plant. The unit was designed, engineered, and licensed by Universal Oil Products Co. It was built by refinery personnel.

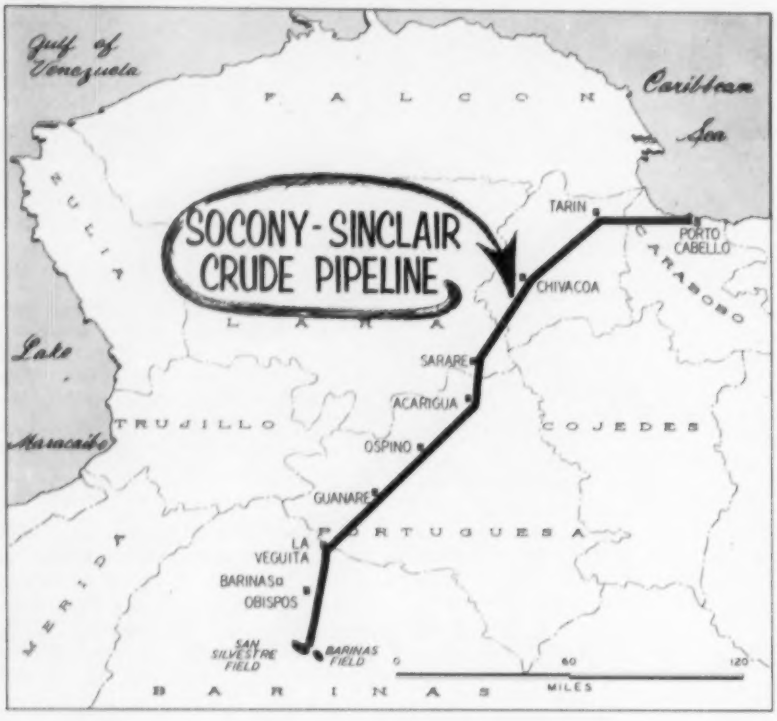
**WILMINGTON, Del.—DuPont last** week abandoned the $32.25 terminal charge for deliveries of tetraethyl lead to tank trucks and put trucks on the same pricing basis as tank cars.

David H. Conklin, director of sales for the petroleum-chemical division of DuPont, said the move was in line with the company's policy of reducing costs to refiners. Tank truck deliveries of T.E.L. are now available at DuPont terminals in Carney's Point, N. J., and El Monte, Calif.

**CHICAGO. — Second Ultraforming** units will be installed at two plants of Standard Oil Co. (Ind.) subsidiaries. American Oil Co. will build a unit at its Texas City refinery. Pan-Am Southern Corp. will add one at El Dorado. Existing Ultraformers with rated capacities of 21,000 and 8,000 bbl. are now operating at the two plants.

**NEW YORK. — Ethyl Corp. will** build a new plant near Joliet, Ill., to make tetraethyl lead. The company has taken options on the possible site for its fourth manufacturing plant.

Two plants are now producing Ethyl antiknock compound, at Baton Rouge and Houston. A third is under construction near Sarnia, Ont., by a subsidiary, Ethyl Corp. of Canada, Ltd.




# Venezuela Line to Start

## Crude pipeline linking Barinas-Apure basin to Caribbean will make region Venezuela's third major producing area

FIRST pipe for the 211-mile, 20-in. crude pipeline from Venezuela's Barinas-Apure basin to the Caribbean will be laid in December.

The new line will open the interior basin to production and it is expected to make the region the country's third major producing area.

The pipeline will be built jointly by Socony Mobil Oil Co. de Venezuela and Sinclair Oil & Refining Co. Socony will operate the line *(The Oil and Gas Journal, May 7, page 156)*.

The line will have an initial capacity of 100,000 bbl. daily. The two companies hope to start its operation at the rate of 40,000 to 60,000 bbl. daily. Sinclair's Barinas field now has 10 shut-in wells and Socony has 6 wells at San Silvestre and 1 at nearby Silvan.

Final design and engineering for the line have not yet been completed. But because such a crude outlet has long been under study by both companies, the major points involved in building the line are virtually settled. Both companies have shut-in production in the basin and the lack of an outlet has curtailed full-scale development of the fields. The line will probably cost more than $25 million.

**The route . . .** The Barinas station of the line will be located south and to the east of the city of Barinas.

From here pipe crews will move north and east passing Guanare and skirting the mountain range that shuts off Lake Maracaibo from Venezuela's interior. From east of Guanare the line will move northeast to Ospino, Acarigua, and Sarare.

The 15-mile portion from Rio Sarare to Rio Turbio is through a mountain pass where the line reaches an elevation of a little more than 1,210 ft. This section covers the roughest terrain of the route.

From Chivacoa the line will follow the path of least resistance through the mountains to Boraure and Taria and then turn almost due east to Puerto Cabello on the Caribbean coast.

The pipe will make at least six—and possibly eight—major river crossings. It will cross 16 smaller streams that can be spanned. On the major crossings the pipe will be coated, wrapped, and buried. The remainder of the line will be bare and laid above ground on concrete blocks.

**The pump station . . .** The line will be ⅞-in. wall pipe designed to operate under 1,200 psi. from a single pump station initially. Final design of the station has not yet been completed, but Socony officials say it will be at Barinas and will probably be equipped with engine-driven centrifugal pumps.

Present plans call for an electric generating plant to be built adjacent to the station to furnish power for field operations and for the auxiliary station equipment. Four 150,000-bbl. floating-roof tanks will be built at the station, the first to be started in January. Five 267,000-bbl. tanks will be built on a 260-ft. elevation above Puerto Cabello to make gravity-loading of tankers possible. Preliminary plans call for a 24-in. sea-loading line with a 25,000-bbl. per hour loading rate.

# Rig Reaches Egypt

## Sahara will soon put third rig to work on concession

SAHARA PETROLEUM CO., owned by four big American independents, soon will have three rigs operating in Egypt's western desert.

The third rig arrived in Egypt this month. It will drill a well near Mersa Matruh, a village on the Mediterranean coast about 200 miles west of Alexandria.

The first well drilled by Sahara Petroleum (formerly Egyptian American Oil Co.) recently was plugged and abandoned at 13,300 ft. after tests indicated no commercial shows. The test was located 28 miles south of Alexandria.

Mechanical trouble has slowed operation on the second wildcat. The test is currently sidetracking fish at 6,200 ft., after once reaching a depth of 9,157 ft. The well is located 60 miles southeast of Alexandria.

Sahara Petroleum's concession areas cover all of Egypt north of the twenty-eighth parallel, including territorial waters offshore, between the Nile River and the Libyan border. The parent companies are Continental Oil Co., Cities Service Co., Ohio Oil Co., and Richfield Oil Corp. *(The Oil and Gas Journal, March 28, 1955, page 99)*.

**Bids opened . . .** Meanwhile, the oil industry is awaiting Egypt's decision

on applications for exploration licenses on 131,000 sq. miles in the Nile Delta, Sinai Peninsula, and the desert east of the Nile. The bids were opened April 2. They were made under the terms of the newly revised mining law.

Socony and Shell, which already have production in Egypt, were the two major companies which applied for acreage.

Applications also were made by Sahara Petroleum, Tidewater, International Egyptian, Cooperative Petroleum Society of Egypt, Egyptian Oil & Gas Corp., African Oilfields, Ltd., Marcel Wagner for American Near East Associates, and Erich Stollberg. International Egyptian at present has production in Sinai Peninsula.

## New Refining Center

### Details of Panama's oil, chemical plants revealed

THE area near Colon, Panama, apparently is destined to become a major Central American refining center. Two refineries of more than 50,000 bbl. each will be built near the city.

Identical agreements between the Panama Government and the two companies planning to erect and operate the plants were signed last week *(The Oil and Gas Journal, May 14, page 116)*.

The two companies are the Panama Refining & Petrochemical Co., Inc., which includes both Panama and U. S. capital, headed by John M. Shaheen, New York; and the Panama Refining, Inc., which is wholly owned by D. K. Ludwig, large-scale tanker operator.

Panama will levy a 1-cent duty on each barrel of imported crude oil. Both companies made advance duty payments of $200,000 on signing the agreement and will furnish $500,000 bonds to guarantee import tax payments. In addition, each company will establish 20 scholarships for Panamanians for specialized studies abroad in the field of oil refining.

The government exempts the companies from import duty on materials, equipment, and machinery, but does not exempt them from real estate, income, or social security taxes.

Shaheen said crude for his plant will be tankered from Colombia and Venezuela for processing and then sold back to the suppliers. He said his company already has sold its entire production for the first 7 years of operation.

The two refineries will be the first between Mexico and Colombia. They will be located on the Atlantic coast near Colon.

## Fawley Expanded

### ● Esso Petroleum builds big fluid cat hydroformer at British refinery

THE new 14,000-bbl. fluid catalytic hydroformer built by Esso Petroleum Co., Ltd., at its Fawley refinery in Great Britain was completed in 1 year and is now in operation.

The 218-ft. unit upgrades low-octane raw naphtha from the refinery's distillation units into high-octane gasoline components. It was built at the cost of $11,200,000.

Shown in the picture are the catalyst storage hopper (the ribbed tower), the units reactor, regenerator, and the scrubber tower. The refinery has a daily throughput of 150,000 bbl. It has a number of other special process units, including a 40,000-bbl. catalytic cracker and a 2,600-bbl. alkylation unit.

### Russians Plan Record Tanker

Russia reports that a 25,000-ton tanker "incorporating all the latest achievements of shipbuilding" has been designed at the Black Sea port of Odessa.

Larger than any commercial vessel hitherto built in the Soviet Union, the tanker would have engines rated at over 20,000 hp. Under its Sixth Five Year Plan (1956-1960), Russia plans to complete 460,000 tons of ocean-going tankers.

## Rig Going to Sahara

### Promising Algeria border discovery to be evaluated

A HEAVY rig was being assembled in northern Algeria last week for shipment more than 1,000 miles south into the almost inaccessible Sahara Desert in an effort to evaluate the discovery made there by a French-Shell company.

Cie. de Recherches et D'Exploitation de Petrole Au Sahara (C.R.E.P.S.) said last week that its Edjele 101, near the Libya-Algeria border, tested about 19 bbl. an hour of "light oil of good quality" from a sandstone at about 1,475 ft. This confirms previous reports of the discovery *(The Oil and Gas Journal, February 13, page 95; April 2, page 93)*.

If future drilling confirms the discovery, it could open an entirely new oil-producing province.

The new and heavier rig will be moved into the desert at a time when drilling conditions will be worse than those already encountered in that area.

Temperatures in the region soon will reach 130° in the shade. C.R.E.P.S., in order to drill the discovery well, had to haul 65 bbl. of water daily more than 110 miles to the drill site. The well is 185 miles from the small oasis at Fort Flatters, a French Foreign Legion post in the desert.

C.R.E.P.S. officials said last week that water for future drilling will come from a new water well which has been drilled. But that's still more than 50 miles from the drill site.

C.R.E.P.S. is owned 35 per cent by the Royal Dutch-Shell Group with the remainder in French control. The major interest in the company is held by Regie Autonome Des Petroles.

### Esso, Gulf Order Tankers

The latest shot in the arm for the world shipbuilding industry—and the eventual world tanker fleet—was announced last week by two of the world's major oil companies.

Esso Standard, S.A.F., (Jersey Standard) announced in France last week that it will order 10 supertankers of 38,000 tons each between now and 1965. Serge Scheers, president of Jersey's French affiliate, revealed the plans at the launching of Esso France, a 37,000-ton tanker which is France's biggest and fastest.

In Britain, officials of Furness Shipbuilding Co., Ltd., said they have reached an agreement with Gulf Oil Corp. to build four 40,000-ton tankers and two 18,000-ton oil carriers between now and 1961.

# Haifa Draws Exploration Play

HAIFA, Israel, famous as the location of a key Middle East refinery, is now drawing attention as the scene of exploration play.

Only a few open fields separate a deep test, the 1 Haifa, from the 88,000-bbl. refinery, visible in the distance. Pan-Israel Oil Co. and Israel-Mediterranean Petroleum, Inc., are drilling the well on a jointly owned 80,000-acre license on the eastern outskirts of Haifa. Parker Drilling Co. of Israel, which is an associate of Parker Drilling Co., Tulsa, is operating the rig *(The Oil and Gas Journal, April 9, page 82)*.

The well is at 3,100 ft. and is currently having lost circulation trouble. It will seek production in Lower Cretaceous and the top of Jurassic. The projected depth is 8,000 ft.

The big Israeli refinery, which is owned jointly by British Petroleum Co., Ltd., and Royal Dutch-Shell, once was a major supplier of oil products for Europe. It was fed by a pipeline from Kirkuk field, Iraq. The pipeline has been shut down since 1948 when Arab-Israeli hostilities began. The plant now operates at about 20 per cent capacity to meet domestic needs.

Pan-Israel and Israel-Mediterranean also have a well under way about 6 miles southeast of the Heletz discovery, on the northern part of their Urim license. The well, Sedat Akiva 1, is at 3,500 ft.

**Reserves increase . . .** Meanwhile, the two offsets to the Heletz discovery are being completed as producers in the same pay.

On the basis of data available from

the three wells and from geophysics, reserves in the field are now placed at a minimum of about 50,000,000 bbl. There are 5,000 acres with a recovery factor of 600 bbl. per acre-foot. The average thickness of pay is 16 ft.

The 1 Heletz is currently flowing 270 bbl. daily through a ¼-in. choke. It recently produced its 45,000th bbl. of crude. Lapidoth Israel Oil Co., Ltd., and Israel Oil Prospectors, Ltd., hold the license on which the discovery was made.

The 1 Halutza, 28 miles southeast of Heletz, has been abandoned at 5,522 ft. in the Jurassic. Several companies had an interest in the test.

# B. P. Maps Big Kent Expansion

WORK is now under way on the $73-million expansion program that will increase the capacity of British Petroleum Co., Ltd.'s, refinery at Kent on the Isle of Grain from about 90,000 bbl. daily to 140,000 bbl. daily.

The $73-million cost of the program includes 2,600 bbl. daily in alkylation facilities already under construction *(The Oil and Gas Journal, November 14, 1955, page 142)*.

Here are the major process units to be built:

**. . . A single distillation unit** with a capacity of 90,000 bbl. per stream day.

**. . . One catalytic reformer** with capacity of from 8,000 to 10,000 bbl. daily.

**. . . One 10,000-bbl.** thermal reformer.

**. . . Two 10,000-bbl.** Hydrofiners.

**. . . A single crude stabilizer** with 12,000 bbl. capacity.

**. . . Two copper-chloride units** each with 8,000 bbl. capacity.

In addition to the major process units, the company will build two additional jetties along the Medway, storage tanks, about 500 miles of new pipelines with pumping facilities and extensions to the electrical, cooling water, and effluent disposal services.

Principal contractor for the construction of the new facilities is George Wimpey & Co., London. E. B. Badger & Sons will design and erect the distillation unit; Kellogg International Corp., the reformer and Hydrofiners with Universal Oil Products participating in the reformer; Power-Gas Corp., the stabilizers and W. J. Frazier & Co., the copper-chloride units.

# Vote of Confidence

## Austria decides in favor of freer oil by electing Raab

THE international oil industry got a vote of confidence in Austria last week as voters gave Chancellor Julius Raab's conservative People's party a solid victory.

The oil industry was the main issue in the general election, the first since Russian occupation troops withdrew last year. Chancellor Raab's party favored 51 per cent state ownership of the industry and cooperation with oil companies. The Socialists campaigned for 100 per cent nationalization.

Pro-private enterprise conservatives won 82 seats in the new Parliament, an increase of 8. The gain will strengthen the hand of Chancellor Raab in the coalition government he probably will form. The Socialists will have 75 seats, up 2. The extreme rightist party won 5 seats, down 9. The Communists won 3 seats, down 1.

One of the first political moves by the conservatives is expected to be an attempt to water-down the power of Socialist Karl Waldbrunner, the minister of traffic. He took over the Soviet Petroleum Administration when the Russians moved out.

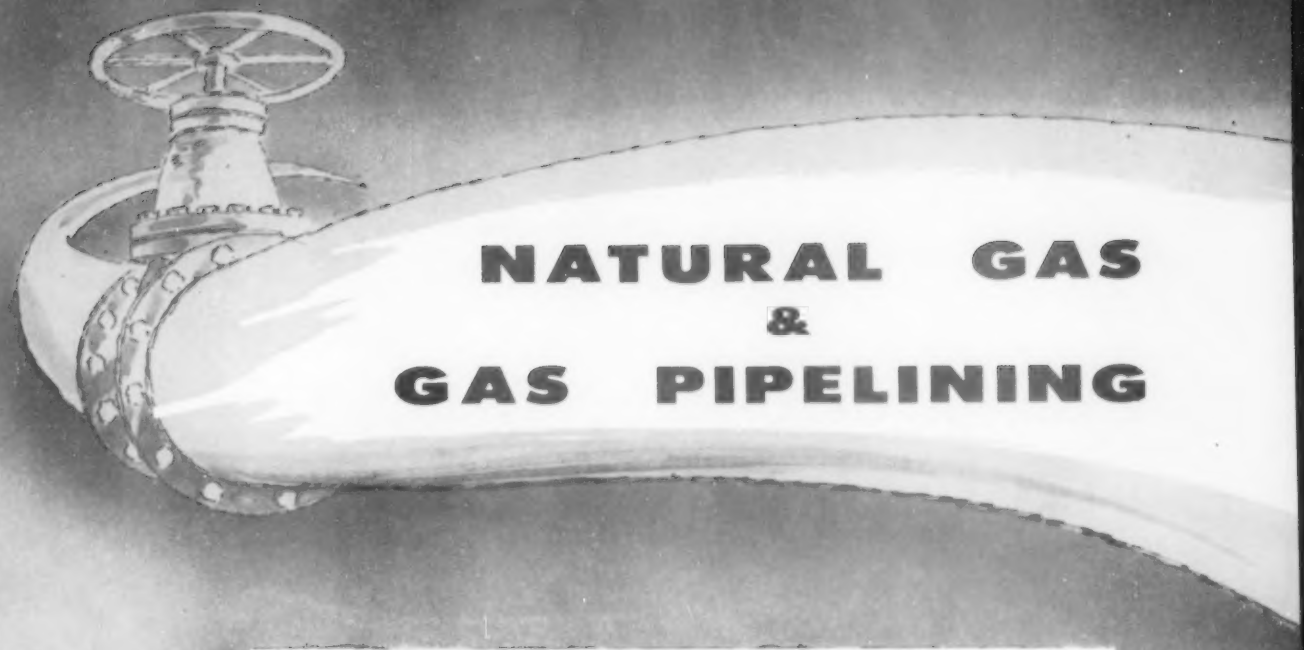
Waldbrunner has kept control of the industry in his hands, despite a set-up under which the People's and Socialist parties each have two administrators to jointly manage the industry organization.

## Petrochem Plant to Expand

Ethylene and propylene output of the Naphthachimie petrochemical plant near Marseilles, France, will be just about doubled.

The Naphthachimie plant was completed early in 1953 and produces an entire range of petrochemicals from a naphtha feedstock furnished by the Lavera refinery of Societe Francaise des Petroles BP. Ethylene and propylene are the plant's main products.

The company announced last week it will increase its ethylene capacity from 10,000 tons a year to 18,000 tons, and its propylene output from 9,000 tons to 18,000 tons annually. The French associate of British Petroleum Co., which operates the Lavera refinery, also has an interest in the petrochemical plant.



# NATURAL GAS & GAS PIPELINING

*Compressor Station Operation—*

LEADING THIS SPECIAL SECTION are five articles jam-packed with information on station operation—the heart of gas pipelining. The first shows how to supercharge an engine by tuning exhaust and intake piping. Others are on station automation, engine testing, ignition systems, and station design. We've also included articles giving details of construction on the large gas projects now under way.

*Field Processing—*

HERE'S A NEW DEVELOPMENT in dehydrating natural gas which promises much lower costs and greatly increased efficiencies. It's a new, small, short-cycle, dry-desiccant adsorption unit for application at the wellhead. This fully automatic, self-contained, and skid-mounted unit may be used not only to dehydrate the gas stream, but also to extract most of the heavier hydrocarbons.

*Where are we with FPC?—*

EVERYBODY WAS CAUGHT OFF BASE by the veto of the Harris-Fulbright bill. This includes the federal courts which now have a log-jam of 60 or 70 cases appealing FPC rulings. Just about everything FPC has done since the Phillips decision is under attack. Some court cases, due for early decision, should throw much light on the problem, but final answers will be long in coming.

*a special section of . . .* OIL and GAS JOURNAL

## The author says . . .

"The experimental work described in this article demonstrates that there are possibilities in the tuning of engine exhaust and intake piping. Further experimentation and operation will prove just what results can be expected in the future. Although there are limitations to the use of this system, particularly the requirement of constant speed, there is considerable promise of fairly wide application of the principles used. Certainly the operation of many units now installed could be greatly improved by the use of all or a part of the methods described."

# Yes, Supercharging by Tuning Engine Exhaust and Intake Is Feasible

**by C. S. Kenworthy**

IS it possible to supercharge an engine satisfactorily by tuning the exhaust and intake piping?

Well, we recently completed several months of experimental work on a four-cylinder, four-cycle, 14¼ by 16-in. gas engine normally rated at 260 b.hp. at 277 r.p.m. (175-kw. generator output). And we found that this is highly practical where the engine normally operates at a constant speed and can be brought up to full speed at a light load—as in the case of an a.c. generator unit.

In our particular case, the problem was to handle a 40 to 60-kw. increase in load on a plant consisting of two 175-kw. units (similar to the one tested) and one 188-kw. unit. The engine room containing these units is practically full of present equipment, and is so arranged that it would require a number of changes to make room for an additional unit. True, one of the present units could be replaced with a modern unit of greater horsepower. But either adding or replacing a unit would be rather costly, especially based on the small amount of additional horsepower required.

The two 175-kw. units were originally equipped with oversize generators (good for 275 kw.). And in view of the satisfactory operation of five horizontal engines which had recently been turbocharged, the decision was made to attempt to supercharge the 175-kw. units.

The project was thoroughly discussed with the engine manufacturer's engineers. The decision was made to use a small motor-driven blower designed to deliver air at 1½ to 2-psi. pressure to an evaporative-type cooler. At the time, there was no intention of changing the exhaust and intake-valve timing or of using fuel-gas injection. The blower and cooler were ordered and installed upon arrival.

### Operation of Standard Engine With Motor-Driven Blower and Cooler

Whereas the normal engine would operate at 175 kw. rather satisfactorily with 4 or 5 per cent $O_2$ in the exhaust, it was about at its limit of operation at 210 kw.

A few minutes of supercharged operation at 210 to 220-kw. load caused such severe preignition that the engine could not be run at this load for any long period of time.

To determine the cause of this poor performance, cards were taken with an M.I.T. indicator. Fig. 1 shows the pressure-time diagrams of the exhaust and intake pressures showing the overlap of the exhaust and intake valves. These diagrams show that in spite of an average pressure of about 1¼ psi. in the fuel-gas manifold, the pressure pulses

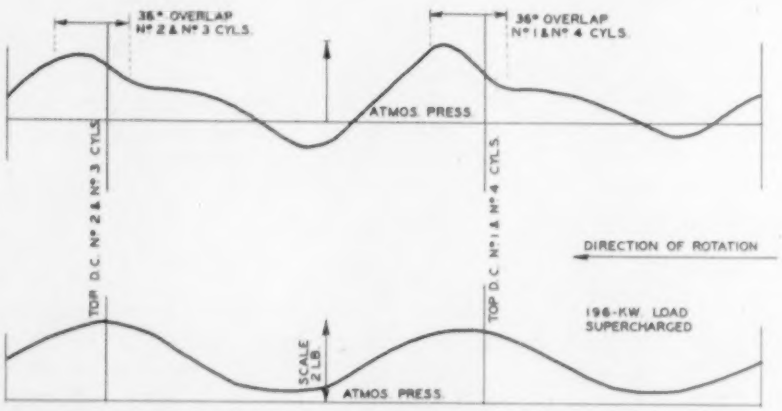



**Fig. 1—Pressure waves in original exhaust manifold (top) and in original intake manifold of engine with blower on (bottom).**

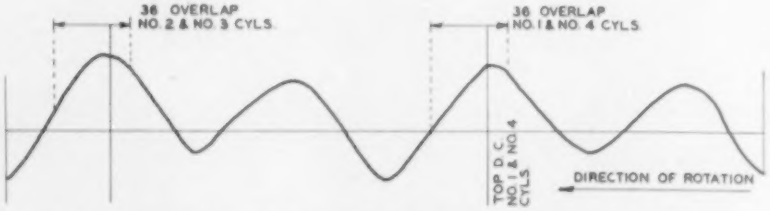



**Fig. 2—Pressure wave in original exhaust manifold with muffler removed.**

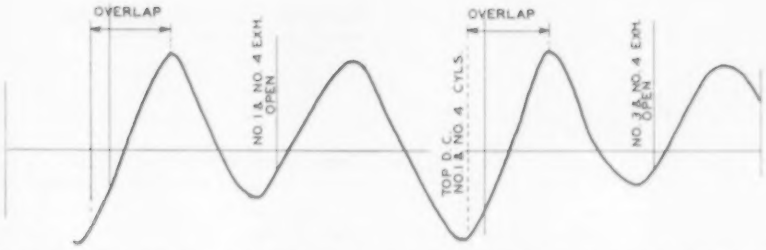



**Fig. 3—Pressure wave in tuned single exhaust manifold with exhaust valve opening advanced from 60° to 80° B.D.C.**

in the exhaust manifold effectively prevent proper scavenging of the cylinder. This would hold true even if the exhaust-intake-valve overlap were great enough to allow a reasonable period of time for such scavenging to take place.

**Exhaust silencer removed . . .** The exhaust silencer was removed to determine the effect it had on the scavenging. Fig. 2 shows the resulting pressure-time diagram taken on the exhaust manifold. The frequency of the pressure wave has doubled due to a much-shorter effective length of exhaust piping. However, a high back pressure is still present during the valve overlap period. There was, as would be expected, no appreciable improvement in engine performance.

It was now apparent that something had to be done to reduce the pressure in the exhaust manifold during the valve-overlap period before the power cylinders could be scavenged satisfactorily.

### Fundamentals of Pressure-Wave Phenomenon

Before covering the experimental work on the manifolds, a brief discussion of pressure-wave phenomenon should aid in understanding the information presented.

First, there are some general statements which apply to pressure waves as in an exhaust or intake manifold:

1. Pressure variations are transmitted at the velocity of sound.

2. The velocity of sound in air (also exhaust gas) at 68° F. is 1,126 ft. per second.

3. The velocity is independent of pressure since the changes of density are compensated by changes in elasticity.

4. Although the velocity of sound increases with the relative humidity, the change is so small it can be neglected for the purpose of these tests.

5. The velocity of sound in air varies directly as the square root of the absolute temperature.

Assuming an exhaust temperature of 950° F. the corresponding velocity of sound is as follows:

Velocity of sound wave at 950° F. $= 1{,}126 \times [(950 + 460)/(68 + 460)]^{1/2} = 1{,}840$ ft. per second.

The length of exhaust pipe required

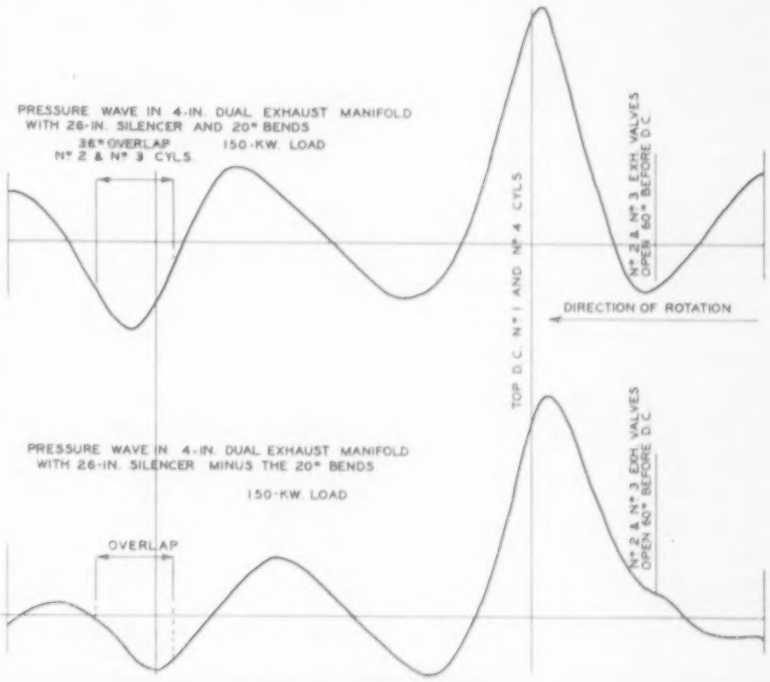

PRESSURE WAVE IN 4-IN. DUAL EXHAUST MANIFOLD WITH 26-IN. SILENCER AND 20° BENDS
36° OVERLAP
Nº 2 & Nº 3 CYLS.
150-KW. LOAD
TOP D.C. Nº 1 AND Nº 4 CYLS.
Nº 2 & Nº 3 EXH. VALVES OPEN 60° BEFORE D.C.
DIRECTION OF ROTATION
PRESSURE WAVE IN 4-IN. DUAL EXHAUST MANIFOLD WITH 26-IN. SILENCER MINUS THE 20° BENDS
150-KW. LOAD
OVERLAP
Nº 2 & Nº 3 EXH. VALVES OPEN 60° BEFORE D.C.

**Fig. 5 (top) and Fig. 6 (bottom).**

**Fig. 4—Dual tuned exhausts consisting of two 4-in. pipes within a 12-in.**

THE AUTHOR

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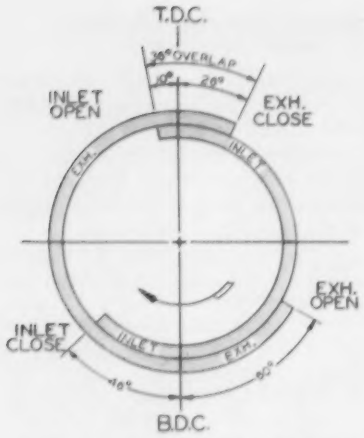



Fig. 7—Valve timing on standard engine.

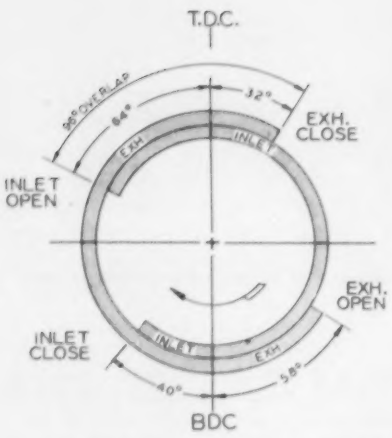



Fig. 8—Final valve timing used on tuned engine.

to produce a given frequency wave is one-fourth of a wave length.

To clarify this, assume:

Velocity of wave = 1,840 ft. per second.

Speed of rotation of engine = 277 r.p.m.

Find the critical length of exhaust pipe to produce a pressure wave with a frequency of 4 cycles per revolution.

(277 r.p.m.)/(60) = 4.62 revolutions per second.

Frequency of wave = 4.62 × 4 cycles per revolution = 18.48 cycles per second.

Wave length = velocity of wave/frequency = 1,840/18.48 = 99.8 ft. per cycle.

Critical length of exhaust pipe = 99.8/4 = 24.9 ft.

The diameter of the pipe does not affect these calculations. However, any bend in the piping with a radius less than four times the pipe diameter increases the effective length of pipe.

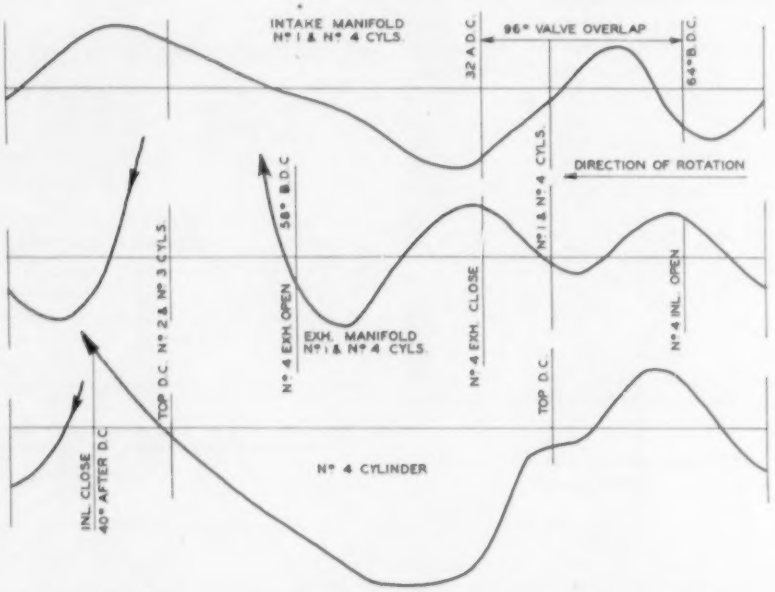



Fig. 10—Nonsupercharged operation at 230-kw. load with 4-in. dual intake manifold.

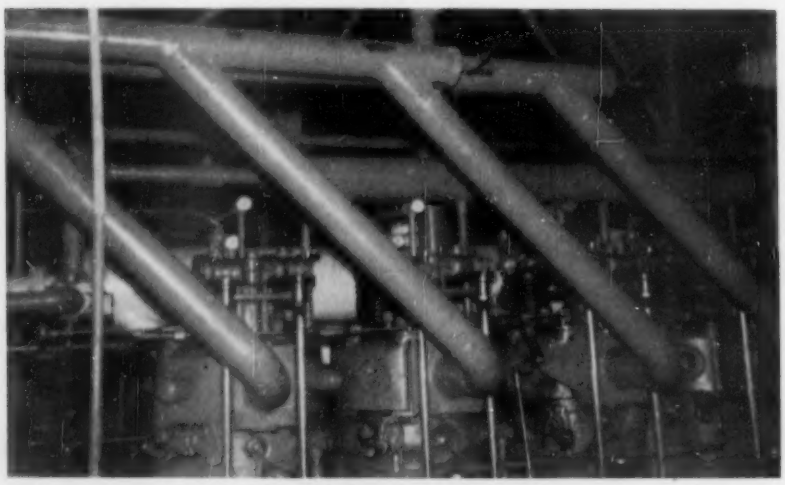


Fig. 9—Four-inch intake piping for engine. Note twin headers.

## Natural Gas—Gas Pipelines

Our tests led to the observation that a 90° long-radius bend produces the effect of 3 to 4 ft. of straight pipe.

**Single tuned exhaust manifold . . .** By use of unusual manifold arrangements of different sizes, we found that a choice must be made between a single exhaust manifold and a double manifold. The possibility of using a single manifold was first investigated. Because of the fact that in a single manifold a forced pulse occurs every time an exhaust valve opens, the choice of frequencies to be used on a four-cylinder manifold is either two or four per revolution.

Two per revolution would require such an early opening of the exhaust valve that it would be impossible. Therefore an 8-in. diameter exhaust pipe was chosen to produce four cycles per revolution. In an attempt to create a vacuum during the period of valve overlap, the exhaust-valve opening was advanced from the standard opening of 60° B.D.C. to 80° B.D.C. By so doing, the pressure wave was set up earlier in the engine cycle.

The pressure time diagram obtained is shown in Fig. 3. The pressure conditions are in most respects similar to those in Fig. 2, but they also show the effect of the earlier exhaust opening. A study of the conditions occurring in the manifold will show that the exhaust from one cylinder is used to create the vacuum for evacuating another cylinder. For instance, with a firing sequence of 1, 2, 4, 3 (as on this engine),

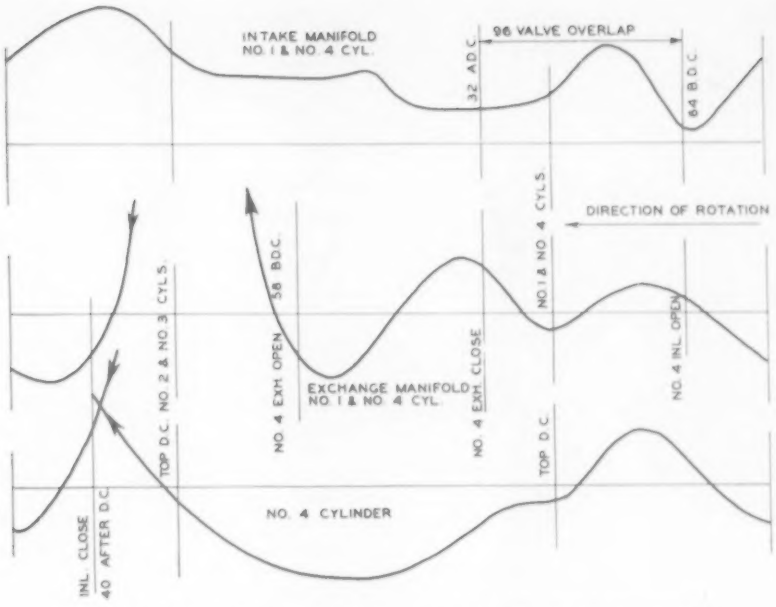



Fig. 11—Supercharged operation at 230 kw. load with 4-in. dual intake manifold.

Fig. 12—Exhaust silencer showing entry of two 4-in. exhausts.

## Natural Gas—Gas Pipelines

the exhaust pulse from No. 1 cylinder is immediately followed by the vacuum that helps to evacuate the No. 3 cylinder.

In designing the dual-exhaust manifold No. 1 and No. 4 cylinders were connected with 4-in. bends to a length of 4-in. pipe. No. 2 and No. 3 cylinders were connected together in a similar manner. This 4-in. piping was covered with a length of 12-in. pipe to serve as a water jacket and thus to eliminate any excessive temperature stresses.

A view of this manifold (Fig. 4), taken at an angle from underneath, illustrates the construction used. This results in a very satisfactory piping arrangement out to the silencer, with the two 4-in. pipes close together and alongside each other. Note that the cylinders connected together are 360° from each other in cyclic displacement.

The two 4-in. exhaust pipes were made long enough to produce a frequency of three per revolution. With this frequency, the exhaust opening is again retarded to 60° B.D.C. and the vacuum which follows at the next dead center evacuates the cylinder. Thus the exhaust pulse from each cylinder creates the vacuum to evacuate itself.

Obviously, then, the time at which this vacuum occurs can be varied greatly by changing the length of exhaust pipe. The longer wave length accompanying three cycles per revolution as compared to the four cycles per revolution used on the common manifold is highly desirable. It allows the use of a longer exhaust-intake overlap, and therefore gives more time for scavenging.

Fig. 5 shows the results obtained on the exhaust and indicates that the exhaust pipe was slightly too long. This error in length was due to the presence of two 45° elbows, for which allowance was not made at the time.

Tests were conducted to determine the effect of load on the pressure wave. Cards taken indicated that the amplitude of the wave increased slightly with a decrease in load. But it was proved that the frequency and position of the pressure wave is independent of load.

**Gas injection valve . . .** It now became evident that to obtain good scavenging of the cylinders, a larger overlap than originally imagined would be required. To prevent loss of fuel during scavenging, it now became desirable to inject the fuel gas under pressure several degrees after the intake valve opening and to have injection stop before the inlet-valve closing. To prevent contamination of the intake air which occurs on light loads when a common air-control valve creates a vacuum on the manifold, individual air-control valves became desirable.

Intake valves incorporating gas-injection valves in their design were ordered from the engine manufacturer. A gas-control valve, to be operated from the governor for controlling the load, was also ordered. Individual governor controlled air valves were designed and built. In addition to installing the above, hand-operated plug valves were installed in the gas line to each gas-injection valve. With all of the above, the load between the cylinders can be properly balanced and proper mixtures can be maintained.

Operation after installation of this equipment proved the necessity of increasing the size of the fuel-gas manifold from a 2 to a 6-in. diameter. When this change was made, it was possible to operate with 7 per cent $O_2$ in the exhaust (a fairly lean mixture) without missing at normal loads, whereas with the smaller manifold it was necessary to maintain 4 per cent $O_2$.

**Tuned air-intake piping . . .** It had now become evident that it was possible to do a good job of supercharging or superscavenging the engine without using a blower, and all of the final tests were conducted with this possibility in mind.

The possibility had been discussed many times of designing an intake manifold which would result in a high pressure in the manifold during the valve overlap and thus further improve the scavenging. If, in addition, a maximum air pressure could be created at the end of the intake stroke and the beginning of the compression stroke, an actual supercharging could be realized.

Tests were conducted at 230-kw. load with a 4-in. single and a 4-in. dual-intake manifold arrangement with a 28° inlet-valve closing. A 40° closing was also used to obtain a maximum supercharging effect. The above tests were conducted with and without the motor-driven blower. M.I.T. cards were taken under the above condition,

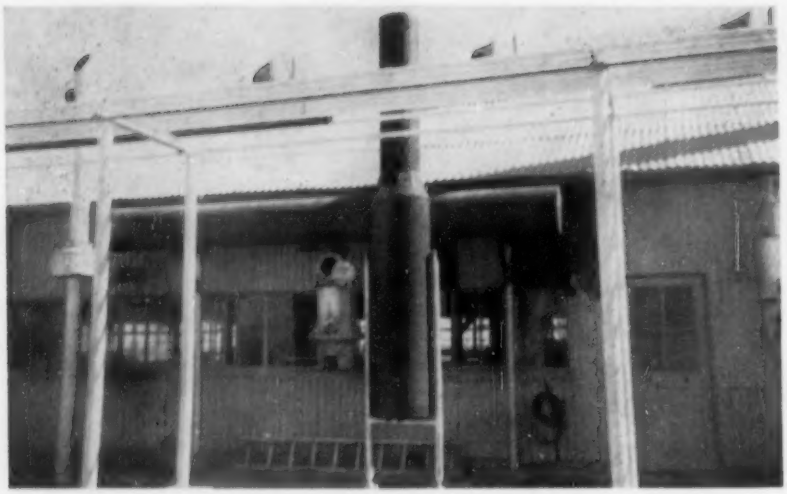


Fig. 13—Exhaust silencer with air intake header behind it. Header feeds two engines.

## Natural Gas—Gas Pipelines

but space allows the inclusion of only the final results.

These tests did demonstrate the advantage of the large 96° valve overlap, and of the later (40°) closing of the intake valves. Figs. 7 and 8 show the original and final valve timing. The dual-intake manifold demonstrated enough advantage to warrant its use on the final tests. This manifold arrangement is shown in Fig. 9.

**Final tests with and without the blower in operation . . .** With 96° valve overlap and with a 40° inlet-valve closing, the engine without the blower was operated at 230 kw. with 6 to 7 per cent $O_2$ and at 290 kw. with 1 to 2 per cent $O_2$. Fig. 10 shows the corresponding pressure conditions in the intake and exhaust manifolds and in the power cylinder during the critical operating events.

With the blower in operation, excess $O_2$ readings of 9 per cent were recorded at 230 kw. load with a 70 per cent position of the gas-control (throttle) valve. At 300 kw., the exhaust gas still contained 3 per cent $O_2$. Fig. 11 shows the operating conditions with the blower in operation.

### Exhaust Silencer Tests

During the testing of the intake and exhaust manifolds, considerable investigation of exhaust-silencer requirements was conducted. For instance, when using a 26-in.-diameter empty shell silencer, it was determined that two parallel exhaust pipes entering the silencer tangentially caused enough wave interference as to be unsatisfactory. Fig. 6 demonstrates this dampening effect as compared to Fig. 5. In Fig. 5, the gas from each exhaust pipe has been directed slightly upward with 45° elbows directed upward at a 20° angle.

The final exhaust silencer used was made with an 18-in. pipe open at both ends and supported concentrically in a 26-in. outside shell. One 4-in. exhaust pipe enters the 26-in. shell tangentially, and the other 4-in. pipe extends through the 26-in. shell entering the 18-in. pipe tangentially. This separates the two streams of gas and at the same time directs the two pressure waves in a rotating motion before they actually contact each other in the silencer. A view of this silencer taken from underneath the two 4-in. exhaust pipes is shown in Fig. 12.

A view of the exhaust silencer and the air intake header which will be used in the final installation is shown in Fig. 13. The horizontal 24-in. (intake) header is designed for two engines, with a baffle in the center arranged so that one combination water-wash, oil-type filter can be used for both engines. The volume in the header allotted to each engine is enough to let the blower be discharged into the header without changing the pressure wave in the individual engine piping.

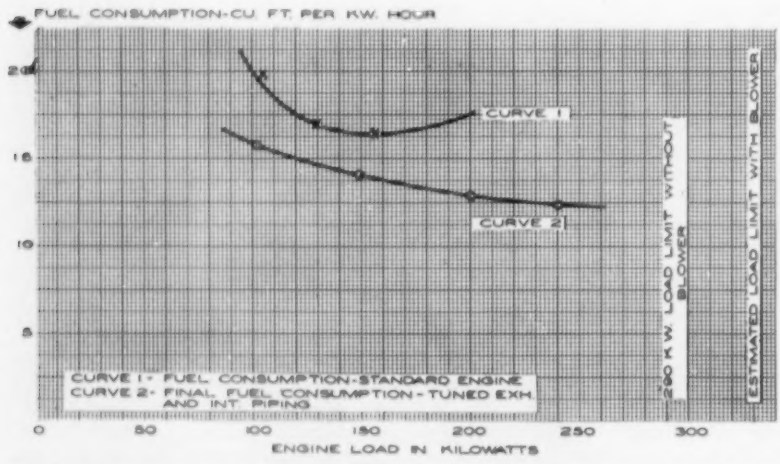



Fig. 14—Fuel-consumption curves of standard engine and engine with tuned exhaust and intake piping.

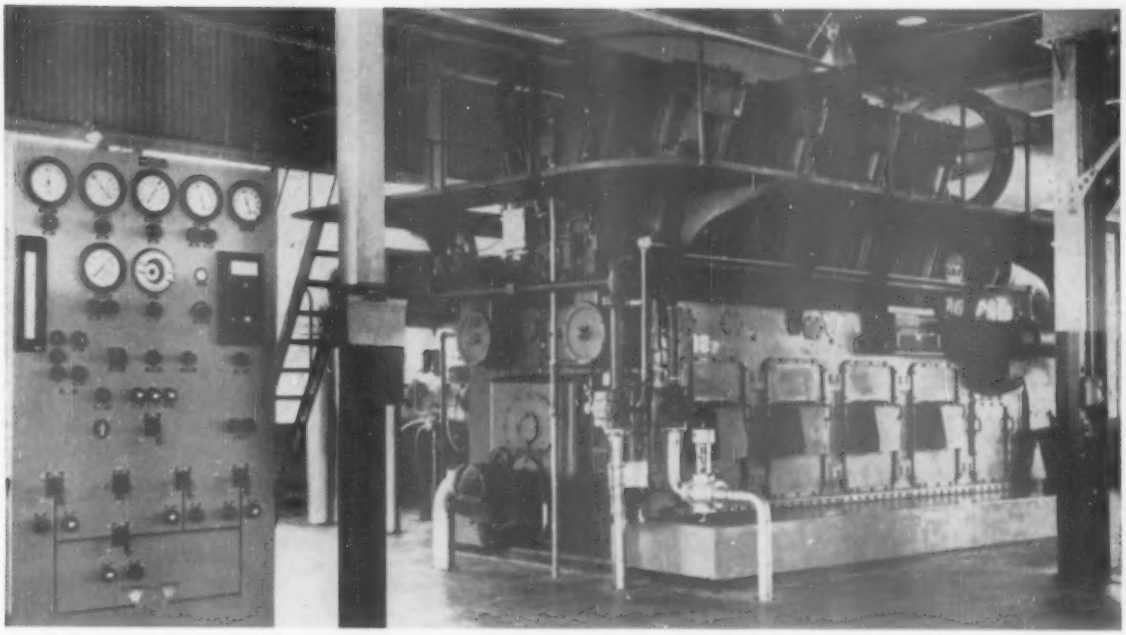
**". . . some standard installations might be improved by minor piping changes. An analysis will show that satisfactory tuning can be had on engines with any number of cylinders."**

**Conclusions . . .** Fig. 14 shows the fuel-consumption curves for the standard engine and for the final engine without the blower. The use of the blower results in very little net gain in horsepower when: (1) the power for driving the blower is taken into account; and (2) the fuel consumption at any ordinary loads is increased because of the blower load.

We intend to put the equipment described in this article on six engines this year. On two of these engines, a blower will be installed. Operation of these units over several months will yield enough information to show whether or not the blower is worthwhile.

In any event, the information contained herein should be of help to anyone interested in tuning engine piping. It might even point out wherein some standard installation might be improved by minor piping changes.

An analysis will show that a satisfactory tuning can be effected on engines with 3, 4, 5, 6, or any other number of cylinders.



CONTROL PANEL and 2,000-hp. engine which is arranged for push-button control.

"Greatly exceeds our expectations," says Great Northern after . . .

# 2½ Years of Gas-Transmission Automation

"Adequate control has been obtained without overcontrol and its problems."

**by D. P. Corkill**

THE word "automation" is becoming a familiar term in the natural-gas-transmission industry, as it has become in other segments of the business world. The performance of automation controls, since October 1954 on a conventional gas-compressor unit at Northern Natural Gas Co.'s Mullinville, Kans., compressor station has been highly successful. As a result of this practical application of automation to the gas industry, the increased use of automatic controls in the future is enhanced.

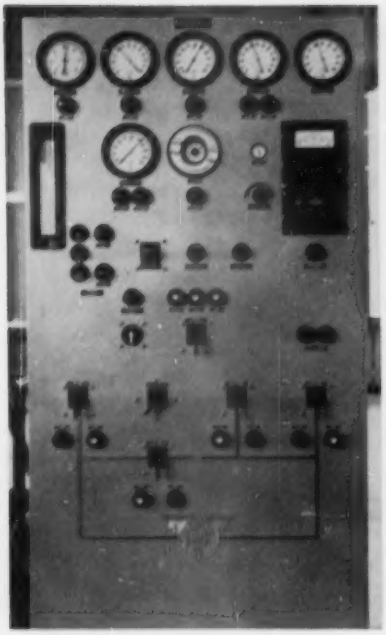
In 1953, Northern installed two gas-turbine centrifugal compressor stations with automatic control equipment which permitted the automatic startup of a unit from a standstill to load speed by momentarily operating only one switch. This system worked so well and had so many advantages over manual operation, that its worth was soon apparent.

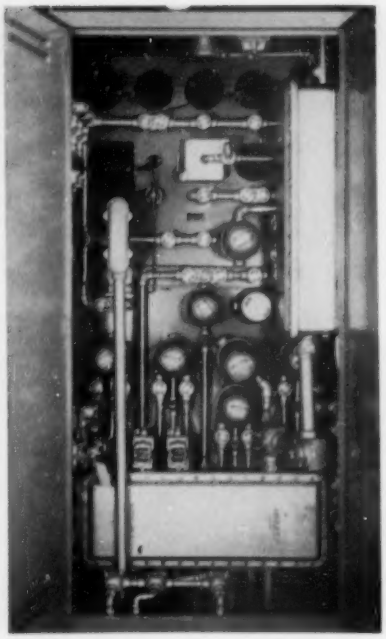
Northern was developing plans during the 1953-1954 winter to further increase the capacity of its transmission system for the 1954-1955 winter heating season. The new compressor units selected for this expansion program were 2,000-hp. vertical internal-combustion gas engines with reciprocating-type compressors. As the automatic controls on the gas-turbine stations were proving advantageous, it was only natural that the possibility of using automatic controls on these internal-combustion engines would be considered in this proposed system expansion.

It was realized that starting and operating characteristics of the internal-combustion engine with reciprocating-type compressor would be very difficult from those of the gas turbine with centrifugal compressor. As the automatic controls had not previously been tried to this extent, on this type machine, it was decided that only one automatic control installation would be attempted during this expansion program. All of the additional compressor units to be installed were to be added to existing compressor stations. As only one unit was scheduled for installation in the Mullinville compressor station, it was selected as the experimental unit.

**How much control? . . .** The next step was to decide what was desired in the automatic control and what it should be designed to do. After a thorough discussion, it was decided that the unit should be designed for automatic operation to the extent that the momentary closing of one switch would initiate all of the operations required to bring the unit from standstill to any load preset, on the speed control. Also, the momentary operating of the stopping switch or operation of any safety shutdown device should return the machine, valves, etc., to the normal position for the machine at standstill.

Power for most of the sequence control is supplied at 110 volts, 60 cycles, single phase, from the plant power supply. A 12-volt d.c. system supplies auxiliary power for a few of the relays to keep the engine operating if a momentary a.c. power interruption should occur. A prolonged power failure would





**CONTROL PANEL has some controls which would normally be at engine. Note in back view the explosionproof construction.**

cause the machine to shut down due to high operating temperatures, as with any machine which has electrically driven water pumps and cooling tower fans. The a.c. power supply is reliable enough at the stations where we have our own generators that in future installations at such stations, the use of the 12-volt d.c. power will probably be eliminated.

The control equipment is mounted in a sheet-metal panel 90 in. high by 45 in. wide by 24 in. deep, with double rear doors for maintenance accessibility. Included on the panel are master unit control switch; control switches for all gas valves (suction, discharge, bypass, blowdown) with indicating lights to show their position; cooling-tower fan-motor control; manometer for scavenging air pressure; pyrometer for engine-cylinder temperatures; speed-control knob; alarm horn; various alarm and shutdown indicating lights; alarm test switch; and gages for starting air pressure, jacket-water pressure, jacket-water temperature, lube-oil temperature, lube-oil pressure, fuel-gas pressure, and engine speed.

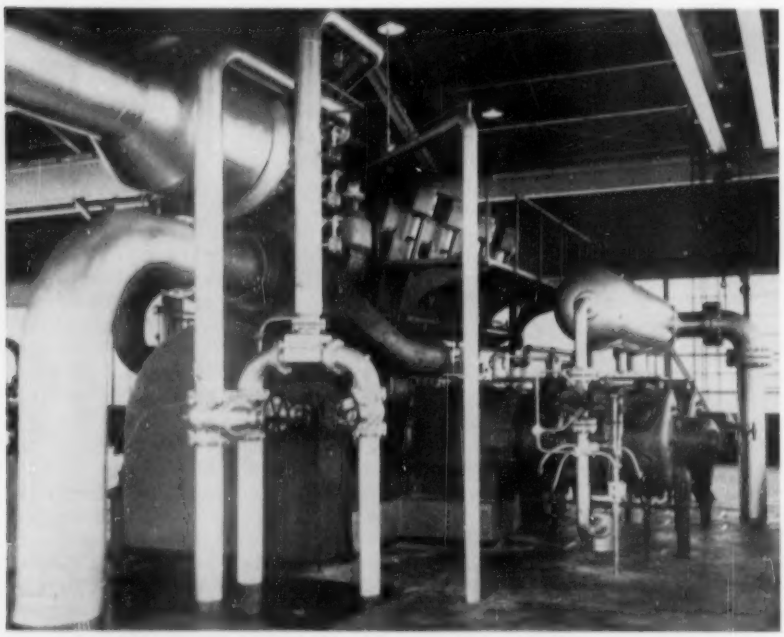
Some of the items on the control board would normally be furnished on an operating panel attached to the engine, but were grouped on this remote-control panel in order to centralize all the controls of the machine.

Automatic valve operators were installed on the suction, discharge, bypass, pressurizing, and blowdown gas valves to the gas compressor. These valves are automatically operated during the normal starting or stopping sequence of operations, but all except the pressurizing valve may be individually hand-operated from the control panel by turning the valve-control switch from automatic to manual position. Hand control of the pressurizing valve from the panel will be included as an added feature in future installations.

An alarm and shutdown system was incorporated in the control system with indicating lights to show which part of the equipment is causing the malfunction. Alarms are included for:

High discharge gas pressure,
Broken compressor valve,
High jacket-water temperature,
Low jacket-water pressure,
High lube-oil temperature,
Low lube-oil pressure,
High exhaust-gas temperature, and
Low control-air pressure.

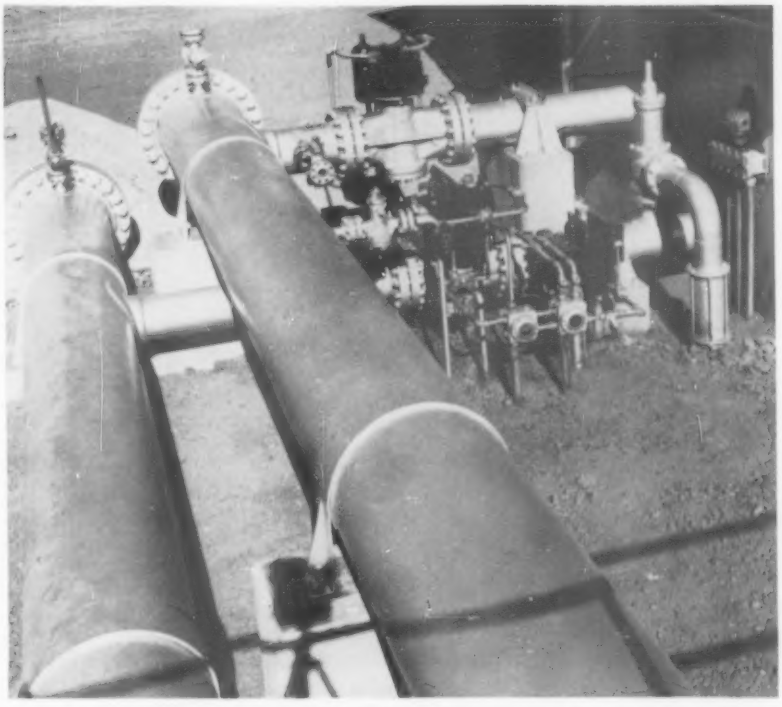
Shutdown is provided for overspeed, low lube-oil pressure, high jacket-water temperature, and high discharge-gas pressure. A push button is used to



**COMPRESSOR SIDE of engine showing bypass valve which is remote controlled.**

**THE AUTHOR**

**D. P. Corkill is presently electrical engineer of Northern Natural Gas Co.'s compressor department. He graduated from University of Kansas in 1940 with a B.S. in electrical engineering. He worked for electric-utility companies in power plants and engineering departments until employed by Northern Natural in February 1950 as electrician for several compressor stations. He served as an inspector during construction of the Tescott, Kans., gas-turbine compressor station and was made assistant superintendent there when operation began. He assumed his present position in March 1955.**



**SEQUENCE-CONTROLLED VALVE OPERATORS** on suction and discharge of the unit.

silence the alarm horn pending the coordination of any of the above malfunctions; however, the individual indicating light for that trouble will remain lighted until normal conditions are restored. An alarm circuit relay is included in the sequence to keep the alarm circuit inoperative during normal starting and stopping of the machine. An alarm test switch is provided to check the proper horn and indicating light operation for each alarm function.

**Starting sequence . . .** During shutdown the suction, discharge, and pressuring valves of the gas compressor are in the closed position with the blowdown and bypass valves open. The sequence of operations during the start-up of the machine is as follows:

The hand-turning of the master control switch to the start position closes contacts to bring the water-circulating pumps into operation. Water-pressure switches close allowing the starting speed-control solenoid, and the automatic control relay for compressor line valves to operate. The pressurizing valve opens to purge the gas compressor and interconnected piping.

The blowdown valve closes after a 3-second time delay, then, through a limit switch on the blowdown valve and another 5-second time-delay relay, the pressurizing valve closes and the discharge valve opens. As the bypass valve is still open this will pressurize all of the compressor piping. Limit switches on the compressor valves are now in the correct position to energize the starting air solenoid and start rolling the engine.

The lube-oil pressure switch closes and energizes a 5-second time-delay relay which turns on the ignition, then operates the main gas-valve solenoid. After the engine reaches the proper speed, the starting air solenoid is de-energized, the compressor suction valve opened, and bypass valve closed. The load can now be applied to the machine by setting the speed control knob on the control panel to the desired setting.

The above starting sequence gives only the essential details of the starting procedure. Switches are incorporated in the circuits to assure that each operation has been completed in the proper sequence before the next step can take place. Relays placed in the sequence put the alarm system, shutdown devices, and safety devices, into the circuits at the proper time.

**Shutdown . . .** The stopping sequence, whether it is initiated by turning the hand control switch to the stop position or by one of the various safety shutdown devices, is essentially the same. The compressor valves automatically return to their normal shutdown position which is with the suction and discharge valves closed and the bypass and blowdown valves open.

The pressurizing valve, having been automatically closed during the starting sequence, remains closed. All relays, switches, etc., reposition themselves in their normal shutdown position during the stopping procedure. After an emergency shutdown, all that is necessary to get ready for a new start is turn the master control switch to the off position, and correct the trouble which caused the shutdown.

This control system could be adapted to remote operation by the addition of the facilities required to transmit and receive the required data between the controlling and the controlled station. Remote operation was not needed in the installation described above as it was an addition to an existing station staffed with personnel required to operate the existing units.

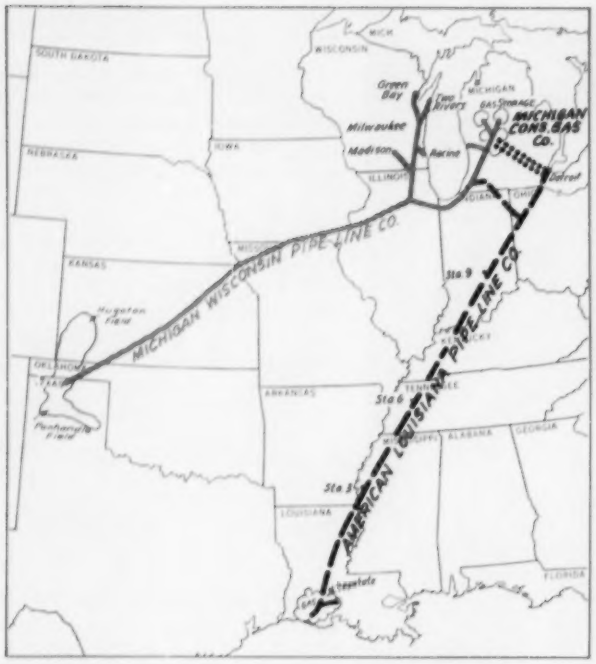
**Future plans . . .** Maintenance work on this automatic control system has been practically nil and the reliability of operation has been excellent. Proposed expansion plans of Northern in 1956 include several additional large-horsepower internal-combustion engines and reciprocating type gas compressors with these automatic controls. As these units are to be installed in existing compressor plant installations, the control panel for each engine will be installed in the compressor building near the engine it controls.

Future company expansion plans include new compressor stations where the engine control panels will be installed side by side in a building separate from the compressor building. This type installation would group the controls for all the units installed whereby one man could handle the operation of all machines from a central control point.

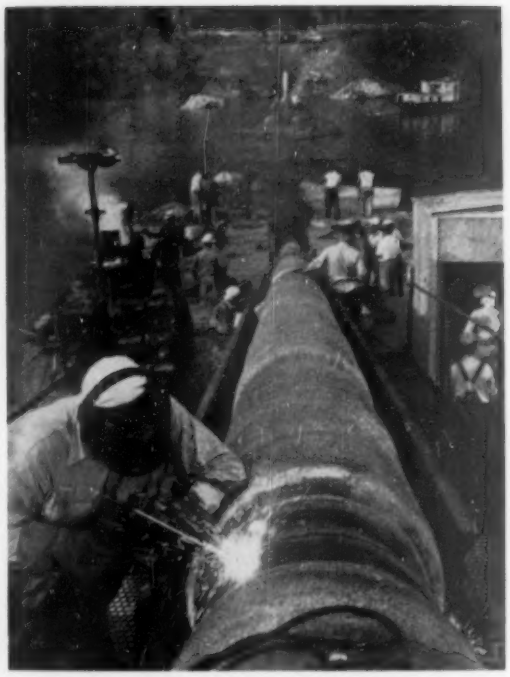
The control panels in the separate building would cost less to buy as they would not need to be of explosionproof design. The relays, switches, etc., would be more accessible for maintenance in the nonexplosionproof panel. The control cabinets would be small enough that they could be installed in one of the other plant structures and not require a separate control building.

Studies are now being made to add additional features to the control system and simplify the existing circuits, if possible, for future installations.

In conclusion, after 2½ years of operation, the performance of this control system has greatly exceeded our original expectations. It is believed that adequate control has been obtained in this installation without overcontrol and its attendant problems.




**RELATION of the American Louisiana system (now under construction) to the existing lines of American Natural Gas Co. affiliates.**



**WELDING OF PIPE on ramp-barge at crossing on the Ohio River near Owensboro, Ky. Pipe is supported on pontoons after it slides off the ramp.**

# American Louisiana Line to Touch Off A Half-Billion-Dollar Gas Expansion

## *... Here are some details of this new $130,000,000 natural-gas system*

**by Paul Reed**

THE American Louisiana Pipe Line Co. system due for completion this summer will be the first of the big gas projects to be put in operation this year. Among long-distance single-line transmission systems it ranks with the biggest in initial and ultimate capacity. American Louisiana is the first trunk line going from the Louisiana Gulf Coast directly to Michigan and Wisconsin markets.

The new American Louisiana system costing $130,000,000 will have 30,000 compressor horsepower at three stations for an initial throughput of 30,000,000 cu. ft. daily.

The 1,170-mile system has a main line of 970 miles of 30-in. pipe. In addition, 85 miles of laterals of various sizes connect the main line with dedicated gas reserves in some 14 fields.

The 30-in. portion of the main line extends from North Tepetate, La., to Detroit.

American Louisiana Pipe Line Co. is a new subsidiary of American Natural Gas Co. and an affiliate of Michigan Consolidated Gas Co., Michigan-Wisconsin Pipeline Co., and Milwaukee Gas Light Co. American Louisiana's line is being built to supply the tremendous requirements for additional supplies of natural gas in Michigan, Wisconsin, and parts of Missouri and Iowa.

**Size and investment . . .** The building of American Louisiana will result in total expenditures of approximately $500,000,000. In addition to the $130,000,000 cost of the line, the undertaking will require drilling of gas wells, building of gathering lines, expansion of gas-distribution systems and sale of hundreds of thousands of gas appliances in more than 160 communities.

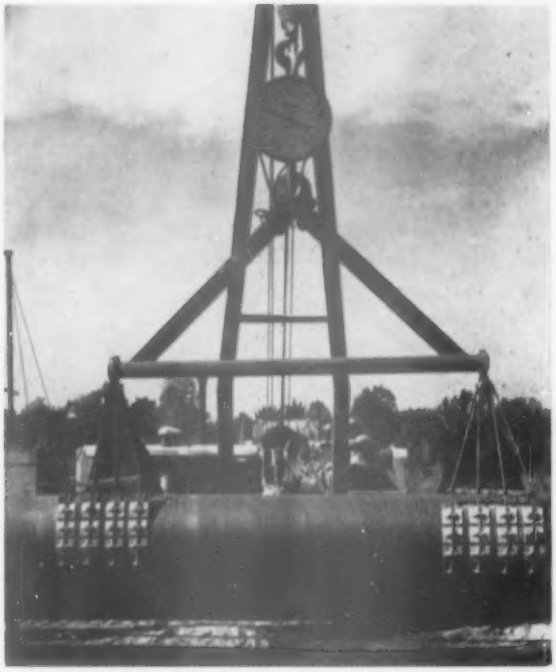
The American Natural Gas system will have a total gas supply of nearly 266.5 billion cubic feet a year. The initial capacity of the new line will enable 16 utility companies to serve an additional 375,000 space-heating customers.

The principal officers of American Louisina Pipe Line Co. are Ralph T. McElvenny, chairman of the board; Henry Fink, president; F. W. Sharp, vice president and treasurer; F. W. Thompson, vice president; and R. D. McClintock, vice president and manager of construction. Operations of the system are supervised by Rex V. Campbell, general superintendent.

Plans are under way for the first step toward expansion to the line's ultimate capacity. In connection with this program, contracts have recently been made with Gulf Oil Corp. and others for nearly a trillion cubic feet of additional reserves in Louisiana.

The first step in this program will be to increase capacity from 300 mil-

TRIPLE JOINTED SECTION of concrete-coated pipe with cars attached being lowered on the tracks of the lay-ramp barge at the Mississippi River crossing.



WEIGHING CONCRETE COATED pipe at coating yard at Mound City, Ill. Each joint of coated pipe was weighed to insure that it had sufficient negative buoyancy.

## Natural Gas—Gas Pipelines

lion to 400 million cubic feet daily. This will require four more stations totaling 42,000 hp. and the addition of 4,000 hp. to the initial three stations to make a total of 76,000 hp. in seven stations.

American Louisiana expects to file an application shortly with the Federal Power Commission for this increased throughput. Ultimately there will be 11 compressor stations having a total capacity of 600,000 cu. ft. daily.

**Compressor-station equipment . . .** The three initial compressor stations are located near Greenville, Miss., Paris, Tenn., and at a point south of Shelbyville and Franklin, Ind.

Each of these three stations is equipped with five 2,000-hp. units, making 10,000 hp. per station and a total of 30,000 hp. for initial operation. These three compressor stations cost about $8,000,000.

**Fuel for compressor** engines will be measured separately at the stations to facilitate determination of the actual volume of gas consumed per horsepower-hour. The compressor engines have a rated consumption of approximately 8 cu. ft. per horsepower-hour.

With the increasing cost of gas in the field, fuel economy becomes more important in compressor station operation.

**Station facilities . . .** Each station has scrubbers, main building, auxiliary building, meter house, and a combined warehouse-garage building. All water wells are on the station sites which generally comprise 20 acres each.

There will be only one residence at each station—the house of the superintendent. All stations are located close to paved highways. This enables station employes to travel readily to their own homes at communities in the vicinity.

Station cooling is done by entirely closed system air coolers. Pulsation dampeners are installed at suction and discharge. All main buildings have basements. Conventional emergency shutdown devices similar to those on other big gas lines are installed at the compressor stations.

**Scraper traps . . .** Scraper-trap installations at all station sites and major river crossings will facilitate maintenance of desirable line efficiency. By having the traps on the line, scrapers can be run in the gas stream with a minimum effect on the throughput of the line. No shutdown will be required.

During construction, the connections for scraper traps are installed for the entire line at all points where they will be needed for initial or future operation. At the eight sites for future stations the scraper trap piping will have blind connections.

At the three initial stations and at all major river crossings, complete scraper-trap equipment is being installed in the original construction program.

At times in the future when stations will be added, the scraper traps at those stations will be installed at the blind connections already at the proposed station sites.

After scrapers have been run about five times through the line for cleaning out construction dirt and trash during early operation, it is expected that scrapers will be run only at 6-month intervals.

In piping design for the system, advantage has been taken of the convenience and economy of extruded nipples for connections at lateral takeoffs.

**Pipeline protection . . .** The pipe along the line is coated with coal-tar enamel reinforced with glass mat. At river crossings the coating is protected by a 12-lb. felt. The rest of the line is wrapped with an 8-lb. felt. In rock country additional protection is given either by dirt padding or rock shields.

In testing the line, there is a departure from customary practices. For pressure testing will be handled by compressor station personnel who will go out along the line during the testing operations. Three mediums will be used in line testing—gas, air, and water. The particular medium for testing each section is determined by condi-

**BIG SUCTION DREDGE at work on the Mississippi crossing. Two and sometimes three dredgees worked on the project to move 5,200,000 cu. yd. of material.**

## Natural Gas—Gas Pipelines

tions. However, all station piping is tested by water pressure.

**River crossings** are laid straight across without any catenary curve.

### Mississippi River Crossing

The problems encountered in crossing the Mississippi River overshadow those on all of the other four major rivers crossed by the American Louisiana pipeline. The cost alone of the crossing of the Mississippi River was between $2,500,000 and $3,000,000, whereas the cost of crossing its nearest rival, the Red River, will be slightly less than $600,000.

The Mississippi River historically is one that is constantly changing its course through erosion of banks on the one hand and the deposit of silt on the other. In planning the construction of the American Louisiana line, the crossing of the Mississippi River had to be in the general vicinity of Greenville, Miss. To place it elsewhere would have unnecessarily lengthened the line and increased the cost proportionately.

To locate the most feasible crossing point in this area, river engineers studied a 20-mile stretch of the river to determine the most stable section in terms of changes in its course. The history of this section from 1881 through 1953 was studied. It was determined that changes in depth, as well as changes in the location of the banks, were least between River Mile Posts 517 and 522. It was also determined that the maximum depth of this area was such that it could be effectively dredged.

The engineers decided that the crossing should be at about Mile Post 519.8. They decided that instead of laying one 30-in. line across the river, two 24-in. lines should be used, these to be laid 500 ft. apart at Mile Posts 519.7 and 519.8. During the period 1881 to 1953 the lowest recorded bottom of the river at this point was 57 ft. above mean sea level. Therefore, it was decided to bury the lines to a depth of 25 ft. above mean sea level under the channel of the river and 40 ft. above mean sea level under the remainder of the river.

**Pipe preparations . . .** To insure against either of the lines being uncovered by erosion of a bank where the line emerges from the river bed, trenches were dredged back 800 ft. into each bank of the river. The 24-in.-diameter pipe with ½-in. in wall thickness weighs 125.5 lb. per foot. It is covered with coal tar, glass fiber, and a second coat of enamel followed by a wrapping of asbestos felt.

This pipe is then covered with reinforced concrete (having a density of 180 lb. per cu. ft. to a thickness of about 2 in. or a weight of about 100 lb. of concrete per foot. This makes the pipe and its coating 1.3 times as heavy as the water it displaces and therefore not susceptible to floating.

Excavation on the Mississippi River started on June 27, 1955, and the project was completed in February 1956. The river at the point of crossing is about 5,000 ft. wide. Add to this the 800 ft. dredged into each bank and we have an over-all water lay of about 6,600 ft. on each line. The trenches have been dredged to such depths that the top of the pipe will be from 32 to 37 ft. below the bottom of the river bed.

To prepare these trenches, two and sometimes three dredges moved about 5,200,000 cu. yd. of material. By adding to this the dirt required to cover the pipe it may be estimated that about 8,750,000 cu. yd. of dirt altogether was moved by the time the project was completed.

Immediately before laying of the lines, the dredges swept the bottom of the trench to remove all silt or debris that accumulated since the dredging. The actual laying of the lines started on the west bank or channel side of the river. The joints of pipe are lined up, welded, and X-rayed, and then coated on the lay barge. The line from the lay barge to the bank was suspended by pontoons which gradually lowered the line as the barge moved farther from the bank.

A deep-sea diver inspected the river crossing line to insure that no logs or other debris had washed into the trench, immediately prior to laying, which would prevent the line from resting properly in the trench. Following this, the dredges pumped the dirt back into the trench to fill it to the original level of the river bottom.

**Test of plastic tape . . .** A significant feature of line construction is the arrangement made for a test application of plastic tape on 10 miles of 30-in., northeast of Memphis in a section contracted by Houston Contracting Co.

This test will be the first opportunity to determine whether substantial savings in labor and equipment can be achieved by protecting pipe by plastic tape, instead of by the usual coal-tar coatings reinforced and shielded by wrappings. From the results of this operation it is expected that data will be obtained which would be helpful in indicating the possibilities of plastic tape for future pipeline construction.

The plastic tape is to be protected

by an outer wrap which consists of glass mat with bituminous saturants.

Block valves are installed along the system at intervals of 15 to 20 miles. Average cost of the 75 main-line valves including installation and appurtenances is $25,000 each.

**Gas deliveries . . .** At the northern-terminal meter station deliveries of approximately two-thirds of the American Louisiana capacity are to be made to Michigan Consolidated Gas Co. About one-third of the gas will be delivered to the Michigan-Wisconsin Pipeline Co. through 117 miles of 22-in.-diameter line to be constructed from the American Louisiana main line near Payne, Ohio, to a connection with the Michigan-Wisconsin line near Bridgeman, Mich.

About one-third for Michigan-Wisconsin will more than double the gas available for customers in Wisconsin, Iowa, and Missouri.

Permission is being sought from the Federal Power Commission to preserve the permanent allocation of 30 million cubic feet daily of additional gas to be available for new communities that have requested gas connections from the Michigan-Wisconsin system. This gas would be sold by Michigan Consolidated and Michigan-Wisconsin on an interruptible program pending FPC action upon service to the new markets.

**Supply . . .** American Louisiana Pipe Line will initially purchase approximately 250 million cubic feet a day from four independent producing companies in the prolific gas fields of southern Louisiana and in the offshore fields along the Gulf Coast where huge volumes of gas are available. The producers are Superior Oil Co., Stanolind Oil & Gas Co., British-American Oil Producing Co., and Kerr-McGee Oil Industries, Inc.

American Louisiana will also purchase an average of 50 million cubic feet a day from Texas Gas Transmission Corp., an interstate pipeline, at a point of connection near Slaughters, Ky.

**Reserves . . .** The original gas suppliers have dedicated reserves in excess of 2.5 trillion cubic feet, sufficient to supply the line at certified capacity for more than 20 years. This does not include the additional reserves which have been purchased to supply the company's first expansion program. As new reserves are developed they will be purchased by the company when they are needed for expansion and future use. Texas Gas Transmission has signed a contract calling for deliveries of 18.6 billion cubic feet of gas a year for 20 years.

**COAL-TAR COATING reinforced with glass mat applied on 30-in. pipe at construction operations near Chrisney, Ind.**

**Peak capacity** for a single day for American Natural can run as high as 1¾ billion cubic feet. This big volume can be achieved by utilizing underground storage fields in North Central Michigan. This storage assists in supplying both Michigan and Wisconsin for peak demands which are 2½ times the total capacity of the three pipelines feeding into the American Natural territory.

Top daily deliveries from these three pipelines are:

| | Cubic feet |
|---|---|
| Michigan Wisconsin Pipeline Co. | 303,000,000 |
| American Louisiana Pipeline Co. | 300,000,000 |
| Panhandle Eastern Pipeline Co. | 127,000,000 |
| Total | 730,000,000 |

Michigan, the principal market for American Natural Gas Co., is fortunate in having large underground storage in Six Lakes and Austin fields in Central Michigan.

Six lakes field, owned and operated by Michigan Consolidated, was completed for underground storage in 1955. It is located 117 miles from Detroit and has capacity of 53 billion cubic feet. This added to the underground storage of Michigan Wisconsin Pipeline Co. in Michigan gives total capacity of underground storage of 100 billion cubic feet.

### Engineering and Construction

The system was engineered by Ford, Bacon & Davis, Inc., in collaboration with American Natural Gas Service Co. The latter company did a major part of the basic planning.

The pipeline system was designed under the latest code of American Standards Association.

Construction of the project was awarded to the H. C. Price Co., Houston Contracting Co., and Brown & Root, Inc. Price and Houston are building the northern 793-mile section, and Brown & Root the remainder.

Construction costs on the 30-in. line will vary from $75,000 to $80,000 per mile depending on the terrain.

The 30-in. pipe used on the project is being supplied by A. O. Smith Corp. and Republic Steel Corp.

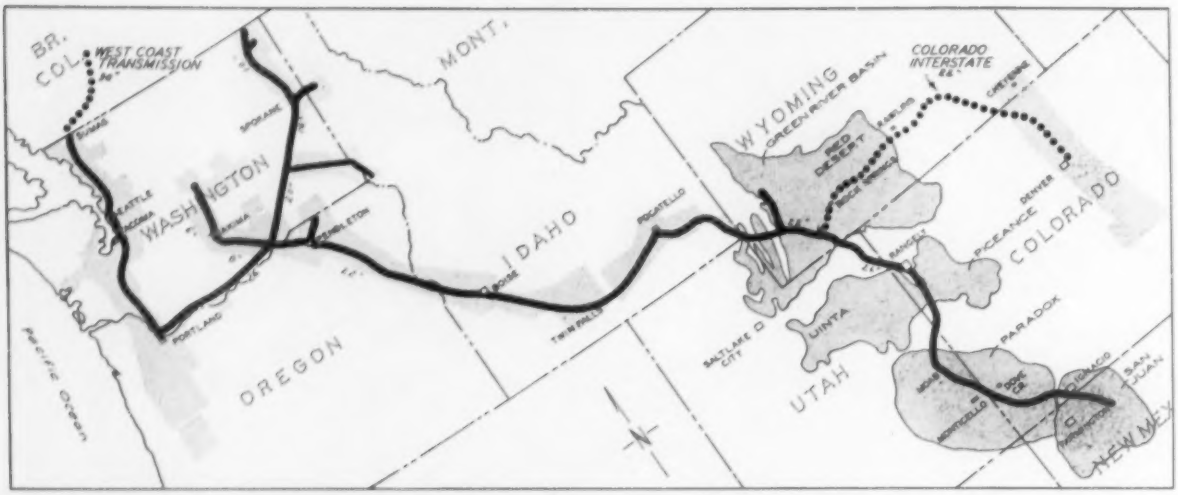
Inspection of construction has been handled by a staff of Ford, Bacon & Davis, Inc. In addition, American Louisiana Pipe Line Co. has its own men inspecting the work.

American Louisiana Pipe Line Co. has its own engineers for handling day-to-day construction matters.

**American Natural Gas Co.** is the big holding company serving the states of Michigan and Wisconsin. It has two big trunk lines—Michigan Wisconsin Pipe Line Co. from the Panhandle and Hugoton areas and American Louisiana Pipe Line Co. which will soon be completed from the Louisiana Gulf Coast. Distribution is principally through two subsidiaries — Michigan Consolidated Gas Co. and Milwaukee Gas Light Co.

**American Natural Gas Service Co.** serves as coordinator of the operations of subsidiaries of the parent organization, American Natural Gas Co.

Planning for expansion of the American Louisiana Pipe Line system is handled as a joint effort of American Natural Gas Service Co. and American Louisiana Pipe Line Co.




**WITH GAS SUPPLIES at both ends, Pacific Northwest has enviable position with rapidly growing markets along line route. Dark areas are supply while light shaded sections are markets. Gas will also come from Canada.**

# P.N.W. Progress Report: 3 Miles per Day

## *Pacific Northwest line moving ahead swiftly despite a severe winter*

**by Joe Reilly**
**District Editor**

PACIFIC NORTHWEST PIPELINE, winding through some of the most rugged country ever traversed by ditch diggers, has been going in the ground at a rate of more than 3 miles per day.

The 22 and 26-in. main line will start moving gas to Portland, one of its main market areas, in about 2 months. Completion of the 1,487-mile main line is scheduled for late 1956.

In less than 12 months since construction started, about 1,000 miles of the main system and approximately one-half of the 800 miles of lateral lines have been completed. Rate of construction has been exceptionally high, despite a severe winter which hampered operations in Idaho and Oregon. Since then, extremely wet conditions have been encountered in Washington.

Originating in the San Juan basin of northwestern New Mexico and southwestern Colorado, the system extends through Utah, Wyoming, Idaho, Oregon, and Washington to the Canadian border. It will supply a large and potentially great market area stretching from Colorado to Sumas, Wash., near the international boundary. Natural gas flowing through the system will be the first ever piped into the Pacific Northwest area, including such metropolitan centers as Seattle and Portland.

Pacific Northwest Pipeline Corp., created specifically to establish and operate the interstate transmission system, claims the enviable distinction of having big gas reserves at each end of its line.

Reserves dedicated to Pacific Northwest in the San Juan basin and Rocky Mountains were estimated at nearly 3 trillion cubic feet a year ago. This figure may be low now because most wells drilled on Pacific Northwest acreage have produced beyond expectations. No current estimate of the company's reserves is available.

After construction began, the company got Federal Power Commission authority to buy up to 300 million cubic feet of gas per day from Westcoast Transmission Co., Ltd., which is building a 650-mile line from the Peace River area of British Columbia and Alberta to the international border near Sumas.

Purchase of Canadian gas assures reserves for future expansion of Pacific Northwest markets. It also had a more immediate effect, bringing a quick change in plans for a pipeline that already was under construction.

**Design changes . . .** As originally designed, the Pacific Northwest main line would have been in the traditional shape of a funnel, starting with 26-in. pipe dwindling to 22-in. and finally to 8 or 10-in. near the northern end.

Since gas now will flow through the line in two directions, the design was changed to that of an hourglass. Pipe on each end of the line now is of 26-in. diameter with the middle portion being 22-in. First segment of 26-in. pipe extends about 390 miles from San Juan basin to the southwest corner of Wyoming where Colorado Interstate Gas Co. will tie into the system to supply markets in North Central Colorado.

From the Colorado Interstate junction to a point near Umatilla, Ore., the main line is 22 in. in diameter. This section of smaller pipe is about 670 miles long. At the northern end of this segment two lateral lines will split off from the main system. One, ranging from 8 to 4 in. in diameter, will serve markets in central Washington. The other, going into the eastern and extreme northeastern part of the state, will vary from 20 in. to 6 in. in diameter.

The main line from Umatilla to the outskirts of Portland and northward to the Canadian line increases to 26 in. in diameter. This segment is more than 420 miles long.

Expansion of the system to handle

**COLD WEATHER SLOWED but didn't halt work through mountains. Terrain on this particular section being laid by Curtis Construction Co. Inc., caused lineup and pipe gang to work "in reverse" for short distance.**

## Natural Gas—Gas Pipelines

Canadian gas boosted cost of the project by $50,000,000 to a total of approximately $217,000,000. It will nearly double capacity of the line, bringing it to 643,000 M.c.f. per day.

**Compressor stations . . .** Pacific Northwest's main line will have 13 compressor stations with a total of 82,780 hp.

The largest, with 12,000 hp., is No. 1 station near the southern end of the line just outside Ignacio, Colo. The line will have 8,000-hp. stations near Moab, Utah; Rangely, Colo.; and the Canadian border. Other main-line stations will include four of 6,000 hp. each, one with 5,280 hp., three with 4,500 hp., and one with 4,000 hp.

In addition, smaller stations will be located on two feeder lines. One, in Wyoming's Big Piney field, is rated at 5,060 hp. The other, in Piceance Creek field of Colorado, has 660 hp.

**Contractors . . .** Engineering work and supervision of construction were assigned to Fish Northwest Constructors, Inc., as agent for Pacific Northwest. Laying of pipe was subcontracted, and at one time there were about 15 companies working on the system.

Companies awarded contracts for main-line construction are:

River Construction Corp., 213.95 miles, three sections.

R. H. Fulton & Co., 167.31 miles, two sections.

Associated Pipe Line Contractors, Inc., 72.75 miles, one section.

Curtis Construction Co., Inc., 138.02 miles, one section.

Montin-Benson Corp., G. G. Griffis, Inc., and Curtis Construction Co., Inc., 137.35 miles, two sections.

Montin-Benson Corp. and G. G. Griffis, Inc., 37.92 miles, one section.

Midwestern Constructors, Inc., 169.93 miles, three sections.

H. B. Zachry Co., 217.40 miles, two sections.

Fulghum Contracting Corp., 189.75 miles, two sections.

A.P.V. Co., Inc., 81.46 miles, one section.

Engineers Limited Pipeline Co., 55.52 miles, two sections.

Laying of pipe started about July 1, 1955. Work on some spreads was held up for a short while because of a pipe shortage, but by year's end construction was completed on about 700 miles of main line and 200 miles of laterals.

Much of the construction work through rugged mountains of Idaho and Oregon was done during midwinter when workers and equipment had to plow through high snow banks. One of the most hazardous sections of the route was through the steep Douglas Pass area of Colorado, more than a mile and a half above sea level.

Subcontractors faced further hazards in the nine major river crossings. The line spans the swift Columbia River at three places. It also crosses Green River three times, Snake River twice, and Colorado River once.

**Personnel . . .** Although a relatively new company, Pacific Northwest has some of the most experienced men in the pipeline business. Ray C. Fish, chairman of the board, formerly was vice president of Tennessee Gas Transmission Co. and was in charge of design and construction of that company's pipeline during the early 1940's.

As president of Fish Constructors, Inc., he directed the engineering, design, and construction of Transcontinental Gas Pipe Line Corp.'s original interstate system. He later founded Fish Pipeline Construction Corp. and did similar preliminary work for Texas Illinois Natural Gas Pipeline Co.

Pacific Northwest's president, C. R. Williams, came to the company from Chicago Corp. As vice president of Chicago Corp. he had been in charge of all the company's operating properties.

Since starting construction of its line, Pacific Northwest has built up an experienced staff in both pipeline and production divisions. Many of its operating men have transferred from other Fish enterprises.

**Production . . .** Much of the gas for the Pacific Northwest line will come from fields developed by the same company.

Since last fall, Pacific Northwest has had about 15 rigs operating full time to develop some 485,000 acres of proved and potential gas-producing land in the San Juan basin. Well completions are averaging 10 per month, bringing total number of wells drilled for the company to about 100.

Before completion of the pipeline, Pacific Northwest plans to have nearly 150 wells producing in the basin. Dry holes have been a rarity. Open-flow potential of producers averages about 8,800,000 cu. ft. daily for each well.

By the time the pipeline has been in operation for 10 years, Pacific Northwest plans to have drilled more than 900 wells on its San Juan acreage.

Northwest Production Co., production subsidiary of Pacific Northwest, recently announced plans to acquire leases on approximately 83,000 more acres in the basin.

Drilling and production operations

are handled out of offices in Albuquerque and Farmington, N. M. Jim Clark, Pacific Northwest vice president, is in charge of production.

**Ammonia venture . . .** Pacific Northwest is counting on continued industrialization of its widespread marketing area to build up demand for its gas. Pacific itself is helping spearhead the drive to move new gas-consuming industries to the area.

Phillips Pacific Chemical Co. is building an anhydrous ammonia plant which will use up to 15,000,000 cu. ft. of Pacific Northwest gas per day as feed stock. The plant is being built on the west bank of the Columbia River just off Pacific Northwest's main line, about 8 miles southeast of Kennewick, Wash. It will be the first plant of its kind in the Pacific Northwest and will produce 200 tons of ammonia daily as agricultural fertilizer.

The chemical company is owned by Pacific Northwest and Phillips Chemical Co., operator of the facilities.

**Other industries . . .** Long before completion of the pipeline, other companies were eagerly awaiting the arrival of natural gas to be used in area plants, actual and proposed.

Fish has pointed out that natural gas "fills the last gap in the basic ingredients" for industrialization of the Pacific Northwest.

"For any area to enjoy substantial industrial development there must be at least three basic essentials—electrical power, cold water, and a satisfactory fuel," he recently told a group of business men at Portland. "The Pacific Northwest area has for many years had two of these. Natural gas is the third element and it will provide the impetus for accelerated economic and industrial expansion of your already growing area."

Here is a summary of recent industrial developments which Fish mentioned in outlining the progress already made, partly as a result of the approaching arrival of natural gas:

. . . Potlatch Forests, Inc., which operates a large pulp plant and the world's largest white pine mill, already has contracted for natural gas to be used as fuel at its Lewiston, Idaho, installations.

. . . Kaiser Aluminum & Chemical Corp. has contracted for a 20-year supply of gas to be used at its plants near Spokane, Wash., and Aluminum Co. of America has contracted for gas to be used in operations near Wenatchee.

. . . Three cement companies have arranged for gas to be used in their plants in the Pacific Northwest.

. . . Several pilot plants are doing experimental work on the recovery of alumina from laterite, a process requiring natural gas.

. . . Chemical Lime Co. is building a plant, as result of Pacific Northwest's line, at Baker, Ore.

Fish emphatically denies that natural gas will compete with hydroelectric power in the area.

Initial volume of gas reaching the Pacific Northwest exceeds in thermal energy the total output of the hydroelectric generating plants in the three Northwest states combined, Fish says.

"Natural gas will relieve the shortage of electrical power and will make it possible to release electric power for wheel-turning energy."

# P.N.W.'s 13 Compressor Stations Will Total 82,780 Hp.

## New pipeline system will use unitized design on stations; line's route dictates special emphasis be paid to winterizing.

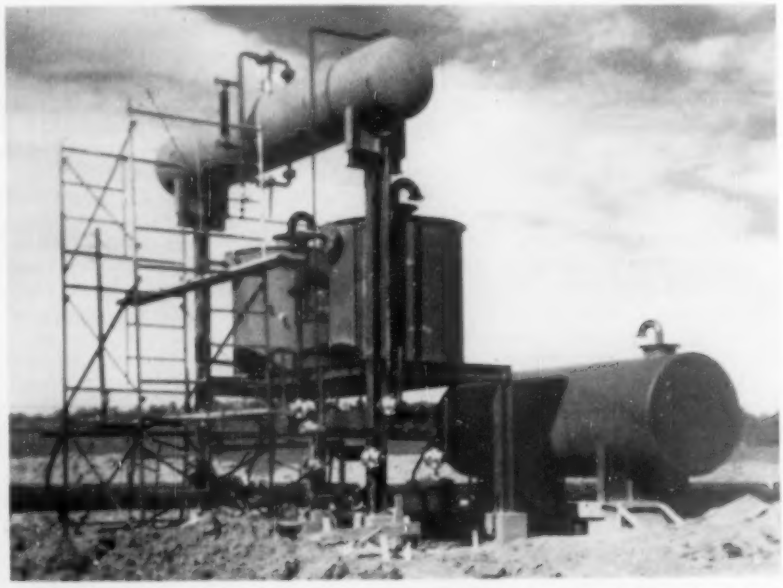
**by James T. Cannan**

A TOTAL of 82,780 compressor horsepower will be installed on the new Pacific Northwest Pipeline Corp. gas-transmission system. The compressors will be located in 13 mainline stations along the line running from the San Juan basin, Northwest New Mexico, to Washington-Oregon.

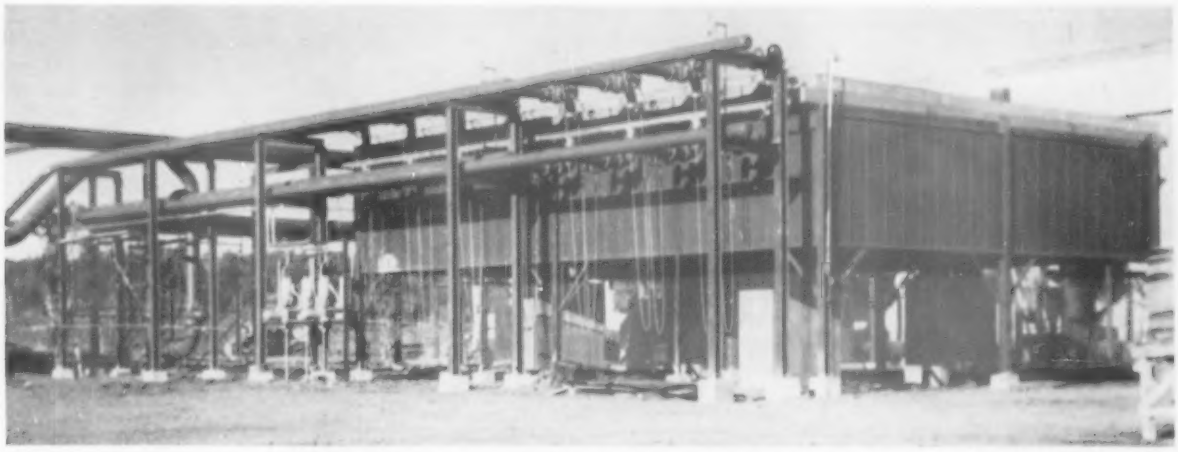
In addition, two booster stations with 5,720 compressor horsepower will be installed to deliver gas into the line from fields along its route.

The geographical route, which passes through Utah, Colorado and Idaho, necessitated that especial emphasis be paid to winterizing of these stations. Scarcity of water along the route contributed to the decision to use air cooling on all stations but the initial one. An additional feature has been the plan to use unitize design on all gas engine-compressors on the main system.

**P.N.W. system . . .** The initial compressor station will be located at a site near Durango, Colo. Gas will enter



**SCRUBBER-OIL INSTALLATION, showing scrubber-oil storage tank, charge tank, and settling tanks.**



JACKET WATER COOLER installed as a four-section unit. This view gives details of overhead piping and valving layout.

## Natural Gas—Gas Pipelines

this station and then the line following extraction of hydrocarbon liquids at a processing plant P.N.W. will build there. Six 2,000-hp. compressors will be used to bring the gas to the 800-psi. line pressure. The 12,000-hp. installation there will be the largest on the line. Other main-line stations will vary from 8,000 down to 4,000 hp.

Booster stations at Piceance Creek field, Colorado, and Big Piney field, Wyoming, will have 660 and 5,060 hp. installed.

Of the 13 stations on the line, 11 are located more than 3,000 ft. above sea level, and 5 of these are above 6,000 ft. The Big Piney booster station is at the highest elevation, 7,325 ft. above sea level.

These altitudes necessitated the inclusion of an aeration factor when sizing the stations. The turbocharged engines, specified for high-altitude operation, are derated according to deration curves as accepted by the manufacturers. This deration is less than used for naturally aspirated engines. An example may be seen at 6,000 ft. where the deration factor is 0.814. For every 1,000 hp. installed, effective horsepower will be 814.

TABLE 1—PACIFIC NORTHWEST COMPRESSOR STATIONS

| Station | Station Comp. hp. | Altitude (ft.) |
|---|---|---|
| 1 | 12,000 | 6600 |
| 2 | 8,000 | 5620 |
| 4 | 8,000 | 6000 |
| 6 | 6,000 | 6120 |
| 7 | 4,500 | 6300 |
| 8 | 6,000 | 4440 |
| 9 | 6,000 | 3000 |
| 10 | 5,280 | 3000 |
| 11 | 6,000 | 3000 |
| 12 | 4,500 | 3000 |
| 13 | 4,500 | 3000 |
| 14 | 4,000 | 1000 |
| 18 | 2,000 | 1000 |
| **Field Boosters** | | |
| 23 (Big Piney) | 5060 | 7325 |
| 24 (Piceance) | 660 | |

**Unitized design . . .** Under initial operating conditions, all stations will be completely dependent on line gas for power. Electric power for auxiliary services will be obtained from a gas-engine-driven generator. Meanwhile, each gas engine driving a compressor will have power takeoffs for its appurtenant equipment. This unitized design is typical of all stations except number one.

The unitized arrangement utilizes an individual hydraulic power transmission system, with a hydraulic oil pump and motor to take power from the engine for driving the aerial cooler fan. A chain-driven, engine-mounted pump is used to circulate the jacket-cooling water. Predetermined water temperature is maintained with varying ambient air temperature by an automatic temperature-control valve operating on the hydraulic oil bypass, which varies the speed of the fan from 0 to 390 r.p.m., depending on engine-cooling requirements.

The hydraulic oil pump, located below the engine-room floor, is driven from the flywheel of the engine, through a V-belt drive. The fan, in turn, is driven by a hydraulic motor, through a right-angle gear-speed reducer.

**Jacket water . . .** Each engine is equipped with a combination jacket-water and lube-oil cooling-water system, in order to simplify operation and control.

The combined system utilizes the principle of mixing hot water from the engine jackets with colder water to obtain desired operating temperatures. A portion of the 170° F. hot water from the engine jackets is bypassed to the aerial cooler, where it is cooled to 120° F. The cold water then flows to the lube-oil cooler, with sidestream going to the turbo intercoolers. An automatic temperature-control valve, on the engine, regulates the turbo-intercooler water temperature. The oil cooler is provided with a hot-oil bypass, which is automatically controlled by a three-way temperature-regulating valve.

The main stream of cooling water leaves the lube-oil cooler at 145° F. and mixes with the 170° F. water from the hot-water bypass, and enters the engine jackets at a predetermined temperature of 160° F. The hot water leaving the engine jackets flows to an individual surge tank inside the building,


THE AUTHOR

**Jim Cannan has had a wide experience in design work in process piping, compressor installations, and general plant engineering. As design engineer with Dow Chemical Co., Freeport 1940-42, he designed and engineered various parts of the magnesium, ethylene dichloride, and ethylene glycol plants. He also was in charge of all engineering work in the ethylene dibromide plant. From 1942-1946 he was in the U. S. Navy being released from active duty as a lieutenant. He spent about a year with Petroleum Engineering, Inc., Houston, before coming to Fish Engineering Corp. in March 1948. He worked as functional piping design engineer on several gasoline plants and was project engineer on six major jobs, including dehydration units on Transcontinental Gas Pipeline Co.'s system, Continental Blacks, Inc.'s, oil-black plant, and a major revamping and expansion program for Phillips Petroleum Co. including 26 booster stations. He became chief project engineer with Fish in August 1955 and in February of this year was made general manager. He is a graduate of Texas A. & M. College, 1939, and holds a B.S. degree in petroleum engineering.**

where it is picked up by the jacket-water pump on the engine and discharged to the aerial cooler, located outside the building, to complete the flow cycle.

Additional flexibility and control of jacket-water temperatures, under extreme fluctuations in ambient temperatures, can be attained by adjustment of manual control on the compressor jacket-water temperature-regulating valve.

This system permits the engine jacket water to be maintained at a constant temperature, which closely follows the cooling requirements of the engine. Unnecessary cooling at startups and during cold weather is eliminated.

**Winterizing . . .** The extreme cold-weather conditions along the route of the line dictated the need for special precautions. These varied from the relative simple arrangement of putting jacket-water coolers on the south side of the compressor building where possible, to the need for special dehydration facilities. The low temperatures prevailing throughout the winter mean extra efforts have to be made to avoid hydrate formation. Hence the gas will have to be handled at a lower dew point than used in coastal areas. Solid-desiccant-type dehydrators with high-capacity desiccant will be installed to dry the gas to meet these requirements.

Antifreeze solution will be injected into the cooling system as needed. Each station includes glycol pumps and will require summer storage for the glycol solutions. All water lines will be buried below the frost line which extends quite deep in some locations. Where meters and instruments are installed outside of buildings, freeze boxes—a wooden frame covered with insulation—will be used to prevent their direct exposure.

The general plan followed has been to house everything which is subject to freezing or poor operation in cold weather. Hence, each compressor building includes a basement which provides additional protected areas at the stations for housing equipment. A lube-oil reservoir will be located in each engine building. This will have the capacity sufficient to handle two engines, and in this manner the oil will always be warm. Starting air tanks and jacket-water surge tanks will also be housed rather than be located outside.

The generally low ground temperatures along the route also led to the decision not to cool the gas stream at each station. With the exception of one special category—the initial station—gas will go through the stations without undergoing any pass through a cooling system. Discharge lines at each station will extend from the compressor building on concrete piers with expansion provided to the main line.

**Shutdown . . .** The emergency station-shutdown system is designed in accordance with general recommendations of the Oil Insurance Association and A.S.A. for natural-gas pumping stations. The shutdown system will operate on gas pressure and is designed to positively accomplish the following related acts:

1. Stop all compressor engines by ignition cutout or grounding and fuel cutoff.

2. Actuate power closing of the gas suction and discharge station side gates to stop all gas flow into the station. The main-line bypass valve, to permit continued flow of gas in the main line, shall be manually operated.

3. Release all station-contained gas volume and pressure through the power opening of the blowdown valves.

4. Extinguish all open-flame-fire devices where escaping gas might possibly be ignited and open all electrical circuits.

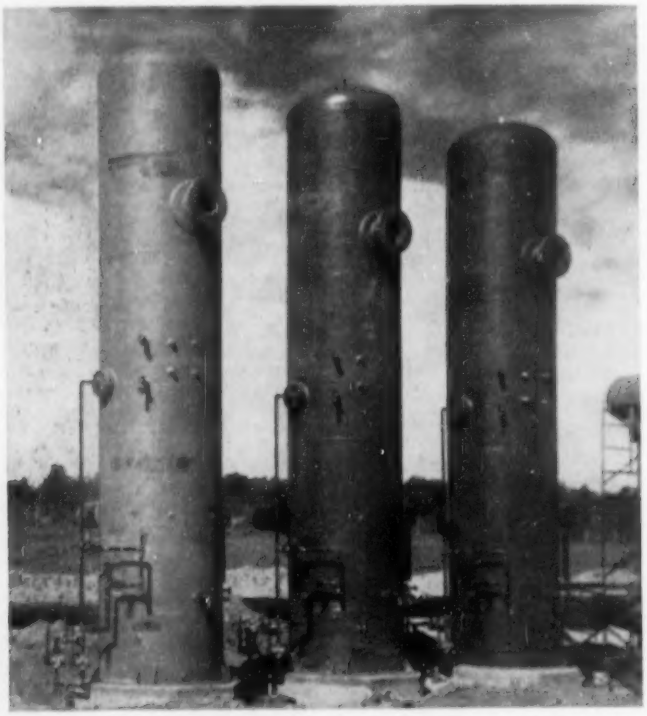
With the exception of some instances noted, station design roughly paralleled that used on Transcontinental Gas Pipe Line Corp.'s system. High-compression-ratio engines, up to 2.0, were installed to take advantage of compactness and higher efficiencies. Pressure drop due to station piping has been held to a minimum since 1 psi. of pressure drop is equivalent to about 40 hp. Gas scrubbers, connecting piping, and valves were carefully sized to minimizing the total pressure drop.

Full-opening, welding-end valves were used throughout the high-pressure system. With the exception of water lines, all piping will be aboveground on supporting structures to eliminate trenching, doping, etc., and make lines readily accessible. Oil-bath scrubbers, with a wide capacity range as well as a wide range for removal of particles were selected for use on the system.

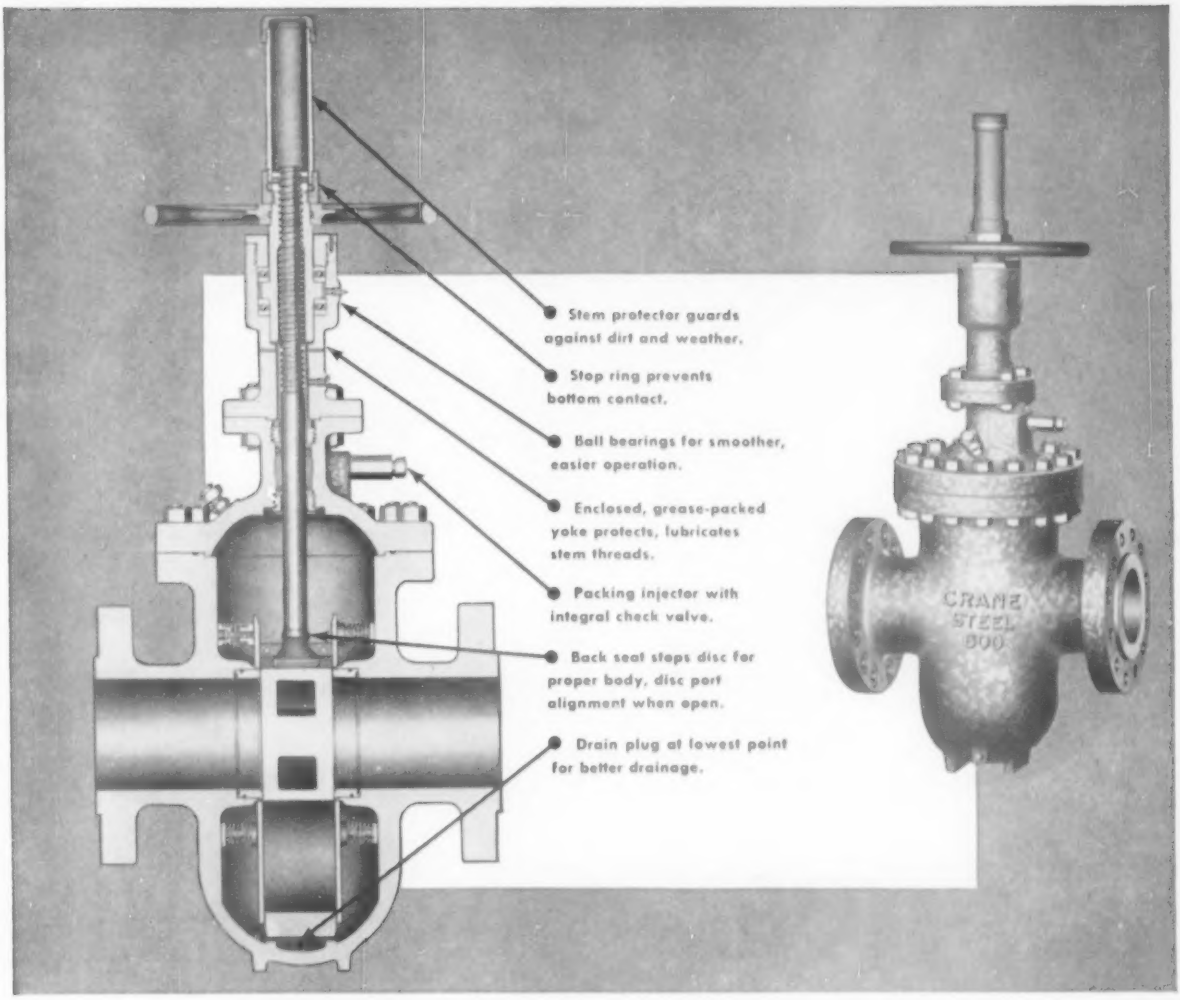
**Three-way station . . .** Station 14 will have an unusual piping-manifold arrangement. Four 1,000-hp. compressors will be installed at this station. It will be possible for the gas to enter the station from the south and be pumped north, or enter the station from the north and be pumped south, or enter the station from the north and south and be pumped to Spokane and Yakima.

The Pacific Northwest Pipe Line is quite unusual in several respects. It is the first major transmission line designed to take in gas at both ends of the line. By so doing it is also unique in having a capacity of 650 M.c.f. per day of gas with no part of the main line being larger than 26-in. diameter.

Fish Engineering Corp. handled all of the design, engineering, and station layout work, while Fish Northwest Constructors, Inc., is responsible for construction of the stations.



**SCRUBBERS on high-pressure inlet gas service to Station 1 at Ignacio, Colo.**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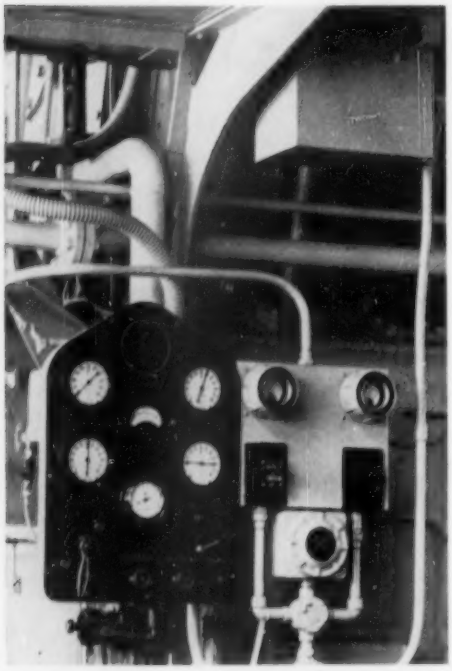
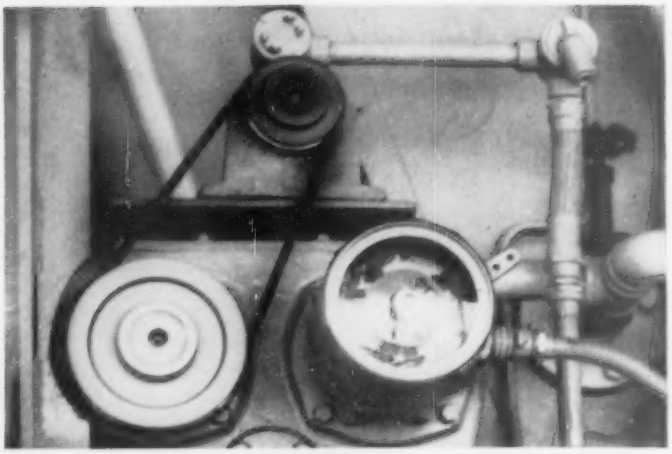
Texas Gas has taken standard components used on automobiles and made them into a low-cost, reliable ignition system for gas-compressor engines. The system is working well and this article gives details of its design and operation.





IGNITION PANEL (left) for compressor engines as designed by Texas Gas. Ammeter, voltmeter, ignition switch, and reversing switch are mounted on panel. Explosionproof fitting houses current-voltage regulator and battery is mounted under engine catwalk just above panel. Modified automobile generator (above) shown mounted on compressor engine. Flexible explosionproof connector at right allows adjusting belt tension. Ignition interrupter is at bottom center.

# Automotive Ignition System Works on Gas-Compressor Engines

**by Aubrey E. Hinton**

GREATER and greater demands are being made upon present-day natural-gas compressor engines in the attempt to meet ever-increasing consumer demand for natural-gas service with existing pipeline facilities. This demand upon the engines increases the need for better and better ignition systems to reduce the number of forced engine shutdowns due to ignition failure.

Texas Gas Transmission Corp. has long been aware of this growing need, and has adopted a system which it has every reason to believe is good, dependable, and low cost. This system is called a generator-voltage regulator-battery combination.

No attempt will be made here to prove that any single type or brand of ignition is superior in any way to another. And no tables of figures concerning voltages necessary to fire spark plugs at varying engine-compression pressures, etc., will be inserted to mislead or confuse the reader.

It is a well-known fact among manufacturers and users that an engine is only as good as its ignition. Both users and manufacturers are constantly and diligently searching for a low-cost, trouble-free system for their engines.

**Major considerations . . .** All ignition systems have their good and bad features. No one can state authoritatively that any one system is superior in all respects to another. The undeniable fact is that too many variables affecting the performance of the system are involved to enable anyone to substantiate such a statement. Some of these variables are:

1. Speed of engine.
2. Type and source of energy (current).
3. Location of source of energy in relation to interrupter and spark coils.
4. Size and type of wire.
5. Type of interrupter.
6. Type of spark plugs.
7. Type of spark coils.
8. Length of primary leads.
9. Length of secondary leads.
10. Intensity of spark flash.
11. Power-cylinder compression pressures.
12. Temperature of burning fuel mixture in the combustion chamber.
13. Capacity of condensers.
14. Cam angle of interrupter.

The major determining factors involved in the selection of any ignition system are: (1) size of engine; (2) type of engine; (3) service required of the engine; and (4) installation and maintenance costs of the system selected.

Even though the above factors are of major importance, some users overlook them entirely and let personal preference be the sole determining factor. Too much deviation in the selection of ignition components usually recommended by engine manufacturers, without a certain amount of experimentation, usually leads to grief. Often an entire ignition system is unnecessarily condemned. Texas Gas did not lose sight of the aforementioned factors in the selection of its system, but it did deviate somewhat in selection of component design. Operating principles remained very nearly the same as most other present-day systems.

**Ignition methods available . . .** The low-tension system, in which the making and breaking of the energy supply

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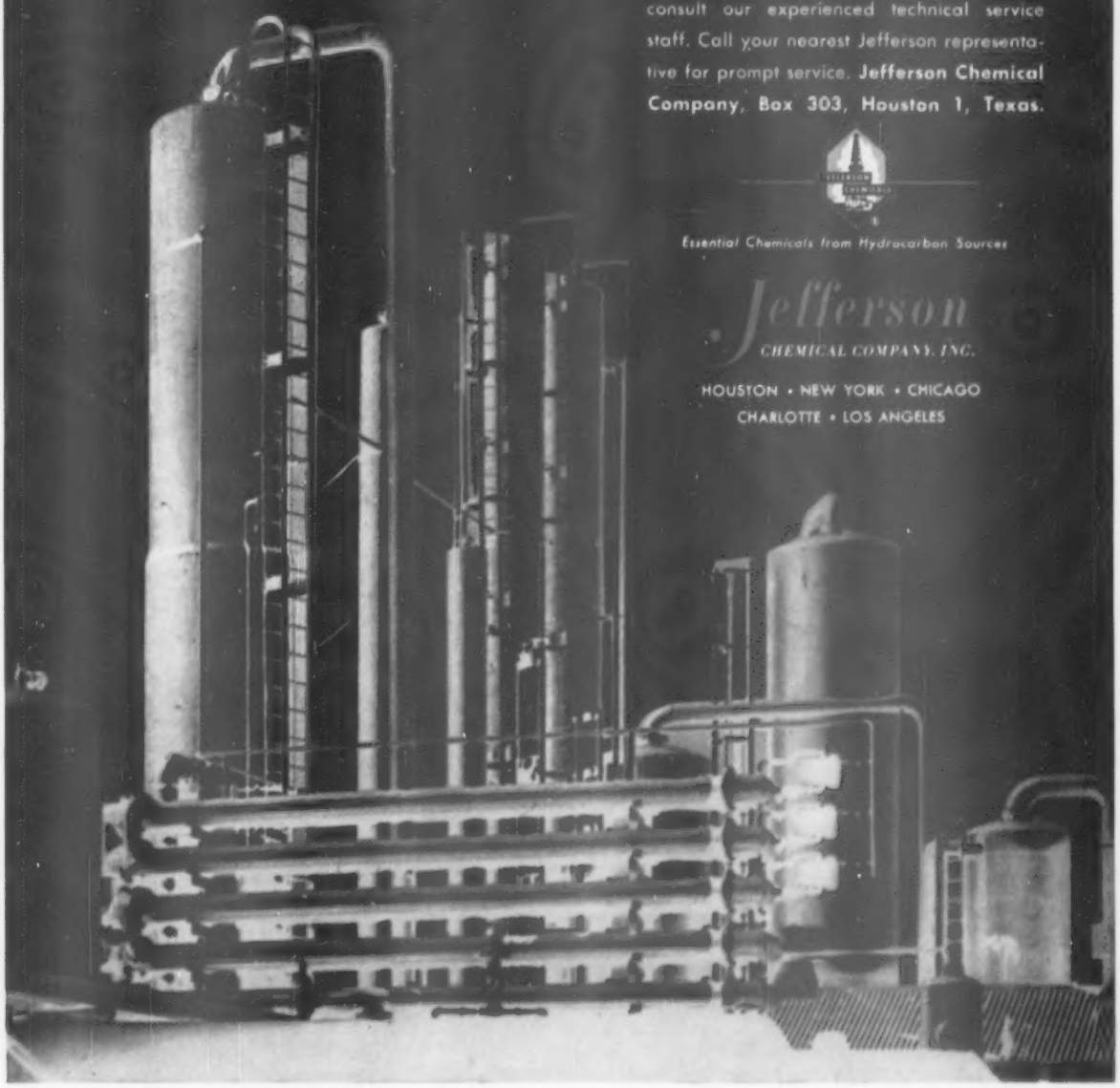
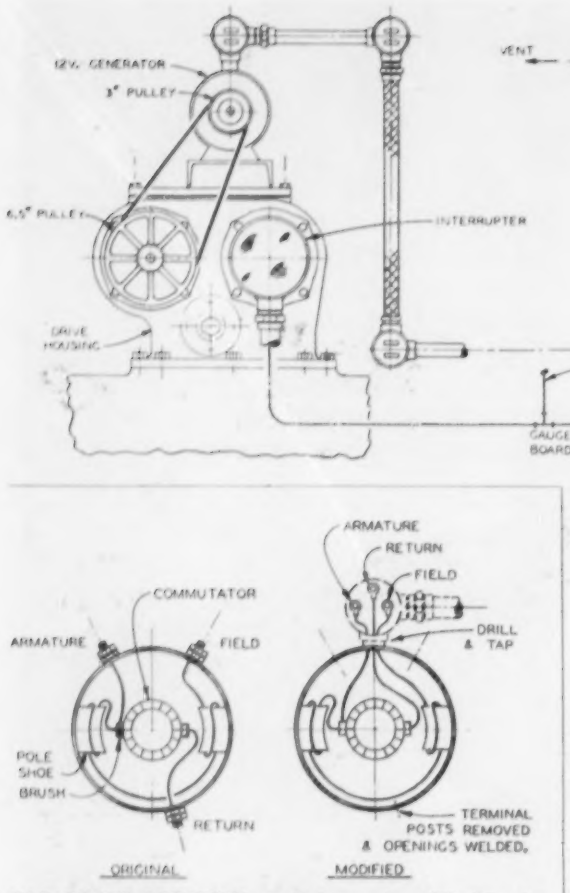
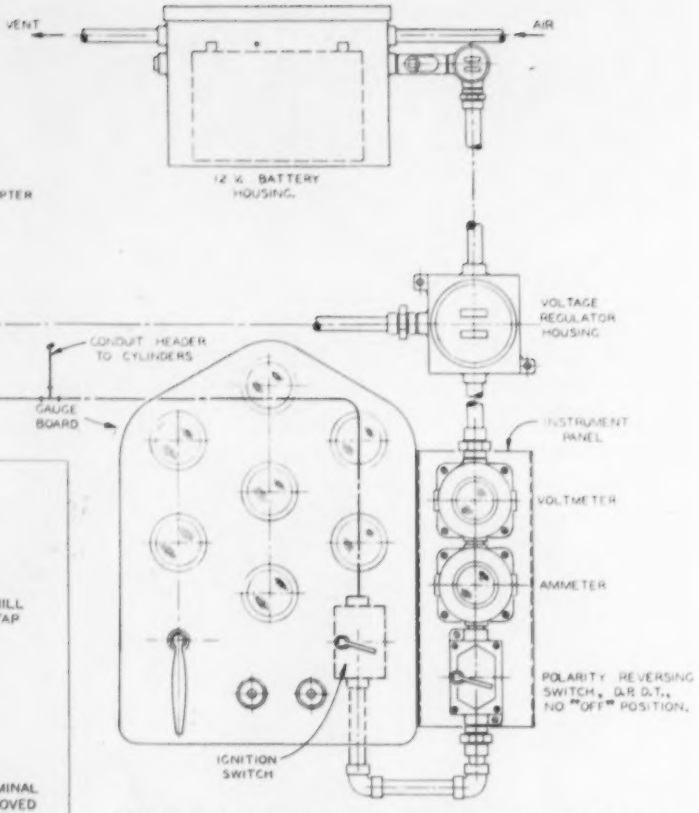





**HAZARDOUS LOCATION required several modifications to be made on the 12-volt automobile generator. Fig. 1.**




**SCHEMATIC of generator mounting, instrument panel, and battery case. Fig. 2.**

## Natural Gas—Gas Pipelines

to the primary winding of the spark coil is effected by means of an interrupter, seems to be the most popular type used on present-day engines. The source of energy supply is usually by one of the following methods:

1. Low-tension magneto(s).
2. Battery charged by a rectifier.
3. Battery charged by a generator.
4. A rectifier supplying current directly to the interrupter(s) from an a.c. source. (When a rectifier is used for a direct supply of current, it is usually the three-phase type. A single-phase rectifier causes a greater percentage of voltage fluctuation.)

Any one of the above methods of supplying current will give good service if proper intelligence and constant vigilance are strictly exercised in its operation and care.

Before selecting any one of the aforementioned methods, Texas Gas launched a systematic experimental program designed to eliminate unwanted features in its ignition systems and to improve upon those considered desirable. Out of this experimentation came several worthwhile features. These are currently being used in conjunction with the generator-voltage regulator-battery combination system. These features are also being used on other battery and magneto units not changed presently to the newer-type system.

One of these features is the use of twin ignition to each power cylinder. Two 6-volt spark coils are connected with their primaries in series in a 12-volt ignition supply. The current that the interrupter contacts are forced to break is no greater in value than that required for one 12-volt coil.

Through experimentation, it was found that an engine operating on twin ignition, with two 6-volt coils in series, results in more positive firing of the air-fuel charge in the cylinder than on a single plug.

Another feature resulting from the research program is a polarity-reversing switch, manually operated, to reverse the current in the ignition circuit at the beginning or end of each 8-hour shift. (The exact period can vary.) Reversal of the polarity three times a day tends to distribute the burning to both breaker contacts and both spark-plug electrodes instead of confining it to only one.

Other features are:

1. The insertion of a resistor in the secondary circuit as near to the spark plug as possible. The resistor cuts down the flow of current at the spark-plug gap after the gap has been jumped, thus extending plug life considerable. Resistors of 20,000 ohms, however, were not satisfactory, so resistors of from 300,000 to 500,000 ohms are necessary.

2. Insertion of a resistor in the primary circuit. This cuts down the voltage being supplied to the spark coils when the coils are too "hot," thus helping to prolong both breaker contact point and spark-plug life. After the spark-plug gap has opened enough


**THE AUTHOR**

**Aubrey E. Hinton is supervisor of electrical engineering for the compressor department of Texas Gas Transmission Corp. which has general offices in Owensboro, Ky., and operates in nine states. He helped develop the ignition system discussed in this article.**

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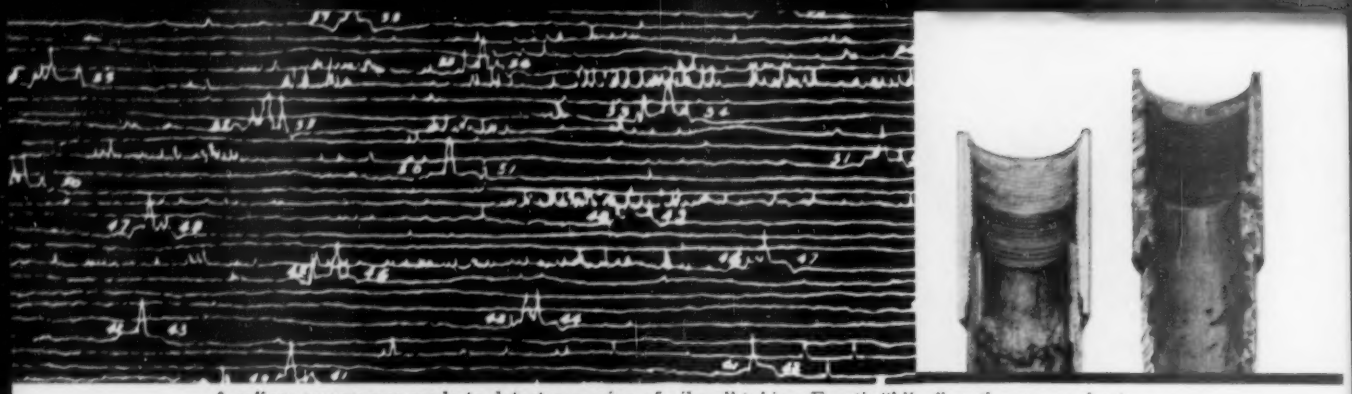
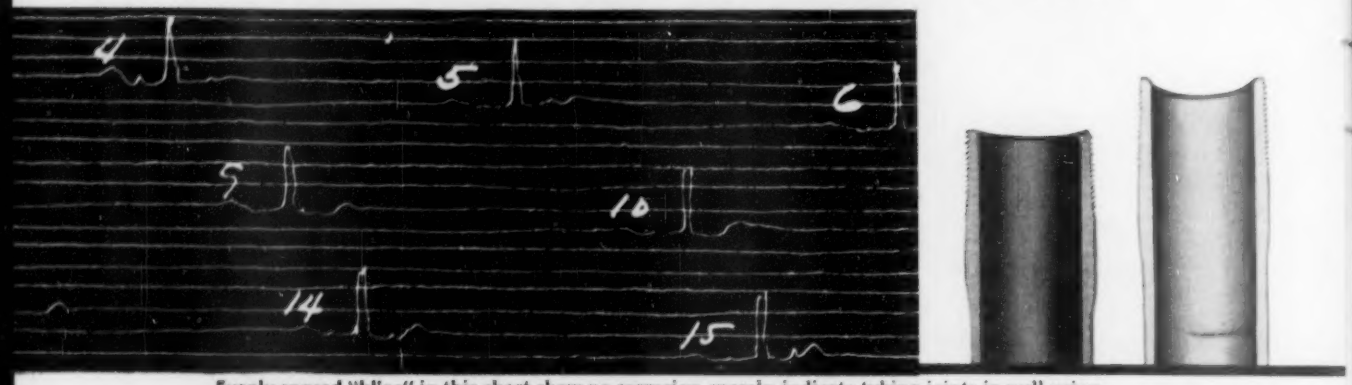


**A caliper survey** was made to detect corrosion of oil-well tubing. Erratic "blips" on the survey chart indicate corrosion in well using ordinary inhibitor. Parts of two corroded tubes are shown at right.




**Evenly spaced "blips"** in this chart show no corrosion, merely indicate tubing joints in well using inhibitor containing Sunaptic acid. The tubes look like new. Both surveys taken after one year.

# KING-SIZE ACID MOLECULE DOUBLES EFFICIENCY OF CORROSION INHIBITOR

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to cause erratic firing, the resistor can be switched out to lengthen the running period before removal of plugs.

Texas Gas is sure that some or all of the features mentioned have been and are being used by other companies. It wishes to claim no credit for their discovery. They are used by Texas Gas simply because they have proved to be very effective in controlling ignition circuits.

**Battery-Generator Method Chosen**

Method No. 3, charging an ignition battery with a generator, was selected by Texas Gas as a source of ignition current supply. The problems confronting Texas Gas were to locate the generator near the battery, place both as close as possible to the ignition interrupter, and provide constant voltage and current regulation. The components selected for this type of installation were: (1) an ordinary automotive-type generator; (2) an automotive-type, combined current-voltage regulator; and (3) an automotive-type battery.

Since these components were to be mounted in a hazardous location to obtain the required benefit, they seemingly would have to be explosionproof. This fact seemed to present an expensive problem because no manufacturer could be found that produced explosionproof or even vaportight equipment of this type. However, the ingenuity of Texas Gas engineers solved this problem. The components selected were revamped so that they would not constitute a fire hazard, and the cost of revamping has been relatively low.

The generator currently being used is a corrosion-resisting type with all brushes insulated away from the generator frame. This isolates the generator completely from an engine ground connection when installed. Generator output is 12 volts, 20 amp.

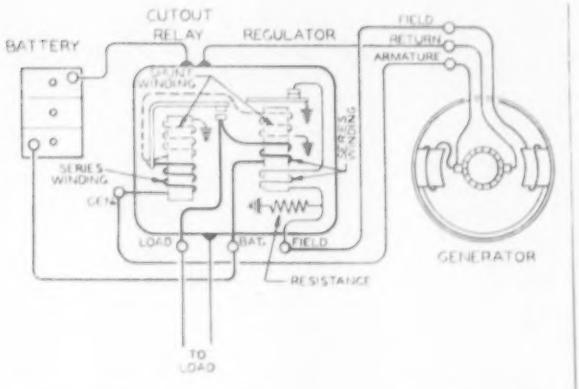
**Generator is modified . . .** It was necessary to seal the generator (which is of open construction) in order to reduce the fire hazard that it would create if left open. To accomplish this, a solid end-bell was cast by a local foundry and machined to replace the original end-bell on the drive end of the generator. The rear end-bell was removed and clamped on a flat surface to prevent warping. Vent openings were closed by brazing.

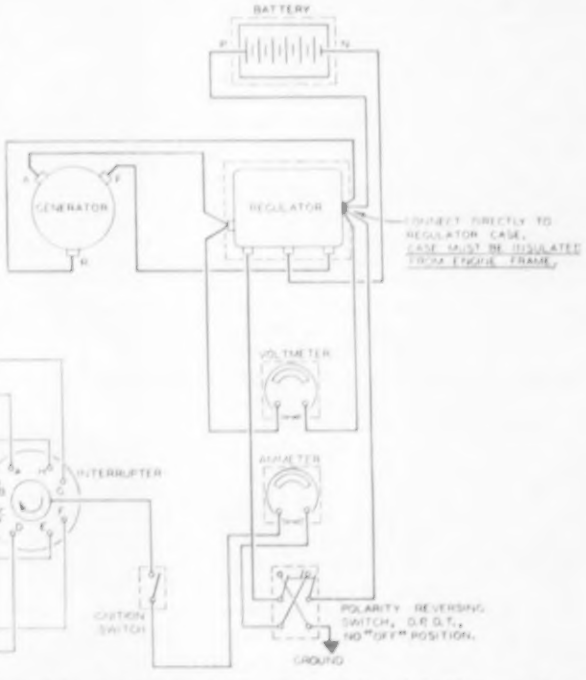
Then the external terminal posts in the generator housing were removed and the resulting holes closed by welding. The generator frame was drilled and tapped at a point near the commutator end midway between the two field-pole pieces. An explosionproof L-type condulet was installed to provide a junction box for connection of the armature and field leads to the current-voltage regulator. An explosionproof flexible connector is used to connect the L-condulet to the other explosionproof condulets, etc. This flexibility allows the generator drive belt to be adjusted for proper tension.

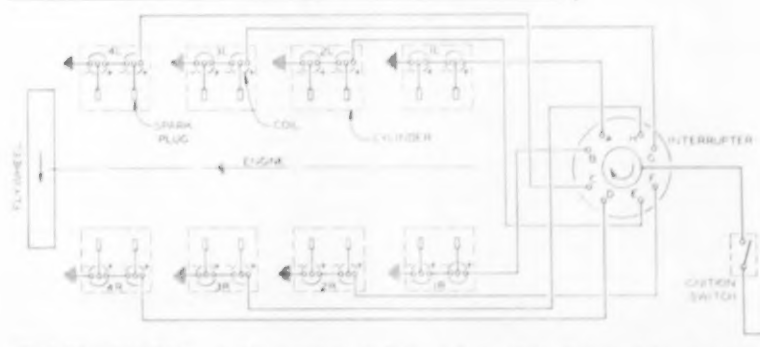
Fig. 1 is a sketch showing an end view of the generator before and after modification. In the upper-left corner of Fig. 2 the generator mounting and drive arrangement, the L-condulet atop the generator, and the flexible connector connecting it to the other condulets.

The generator is driven by means of a V-belt operating on two V-groove sheaves. One sheave is mounted on a drive shaft and the other on the generator. When used on a Cooper-Bessemer GMW or GMWA engine, the driving shaft is installed in one of two drive outlets (upper left corner of Fig. 2). These two drives are intended to serve two magnetos. But an interrupter is used in lieu of the magnetos, the second drive is available. When used on Clark engines, the manufacturer supplied a drive on the end of the engine cam shaft.

The normal operating speed of the generator is attained by selecting the proper ratio of sheaves between the generator drive and the driving sheave. The generating cut-in speed of the gen-




**WIRING DIAGRAM** of the complete ignition system. Note that regulator is not grounded so that polarity of ignition may be reversed. Fig. 3.

**WIRING DIAGRAM** (inset) of combined current-voltage regulator. Fig. 4.

erator is about 1,000 r.p.m. In calculating the necessary sheave sizes, consider the fact that the speed of compressor engines is occasionally cut back to regulate pipeline loads and pressures. The generator must be kept at or above the required cut-in speed, even at the slow engine speeds, and yet must not be so high at normal engine speed as to result in excessive wear.

**Voltage regulation . . .** After analyzing the problems encountered in the regulation of charging voltages and currents, Texas Gas selected a regulator with specifications necessary to meet its requirements. A Model No. 1118779 Delco - Remy, 12-volt, four - terminal, combined current-voltage regulator was selected. It is equipped with rubber shack mounting—i.e., the body of the regulator is separated from the mounting bracket with a cushion of soft rubber to eliminate vibration damage to the regulator.

In ordinary use, the mounting base and relay frame are connected together by a stranded, flexible wire in order to obtain a ground connection. When used in the system being described, this wire is removed, thus insulating the mounting bracket from the relay frame. Reasons for this will be explained later.

The regulator consists of a cutout relay and a combined current-voltage relay. The cutout relay closes the circuit between the generator and battery when the generator attains enough speed to produce charging current. It opens the circuit when the generator slows down or stops. This action prevents the battery from discharging through the generator.

The combination current-voltage regulator provides control of the generator output and circuit voltage, thereby meeting diverse operating requirements.

Close attention must be given to the type of service for which it is to be used, in order to appreciate the operational characteristics of the combined current-voltage regulator. On the natural-gas compressor engines, the charging generator operates for days and weeks with only a very light electrical load on it (usually 1½ to 2 amp.). In hot weather, particularly when the battery is located in a poorly ventilated location or in a hot building, the charging rate may increase to a point where serious overheating of the battery would occur. The regulator must be of the type that is able to control the current flowing to the battery at all times.

Seemingly, a standard type of regulator would work provided it was set at a suitably low voltage. But such is not the case because the low-voltage setting would result in insufficient charge to the battery during cold weather when battery counter voltage is naturally higher. If the battery were located so that it would be kept warm by the engine in cold weather, then by the same token it would become too hot in the warmer months. If the voltage setting was advanced to the point where it would satisfactorily charge the battery in cold weather, it would be so high as to cause serious overcharging when the battery became hot. A standard current regulator only limits the maximum output of the generator and does not prevent battery overcharging at lower rates.

The combination current-voltage regulator is exceedingly effective in overcoming the above faults because of one simple fact. It controls both the battery charge rate and the circuit voltage at the same time.

**Different Regulator From Automobiles**

The combination current-voltage regulator used by Texas Gas is different from the ordinary type of current-voltage regulators used in automotive service in that it has an "L" or "load" terminal in addition to the three regular "Battery," "Field," and "Armature" or "Generator" terminals.

This additional terminal is connected directly to the battery circuit inside the regulator and to the generator whenever the cutout relay contacts are closed. This allows current from the generator to be diverted to the ignition load without passing through the current-voltage regulator. This current does not have a reducing effect on the operating voltage since the regulator is affected only by the current to or from the battery.

This, then, allows the generator output to rise to a point high enough to take care of the ignition load and still supply enough charging current to the battery to keep it in a charged state. If the generator slows to too slow a speed to produce current, or if it stops completely, the ignition load is supplied from the battery through the regulator load winding and the L-terminal to the load.

**How it works . . .** So that the operation and action of the output relay and the combined current-voltage regulator can be better understood, a wiring circuit is shown in Fig. 4. The cutout relay has two windings assembled on one core, one being a series winding of a few turns of heavy wire (shown with solid, heavy lines) and the other a shunt winding of many turns of fine wire (shown in dashed lines). The shunt winding is connected across the generator so that when the generator is operating, voltage is impressed upon it at all times. The series winding is connected in series with the charging circuit so that the generator output passes through it.

The current - voltage regulator has three windings assembled on one core: a series winding of a few turns of heavy wire (shown with solid, heavy lines); a shunt winding of many turns of fine wire (shown in dashed lines); and a series winding of a few turns of fairly heavy wire (shown with medium-heavy lines).

The heavy series winding is connected in series with the charging circuit. The shunt winding is connected across the generator so that voltage is impressed upon it whenever the generator is operating. And the series winding of fairly heavy wire is connected in series with the field circuit when the regulator contacts are closed.

Both the cutout relay and the current-voltage regulator have contact points attached to a flat, hinged armature. This is centered just above the winding core and stationary contact points. The contact points are held open by spring tension on the cutout relay and are closed on the current-voltage regulator.

In the cutout relay, the megnetism induced by the shunt winding (when the generator voltage builds up enough to begin charging the battery) is enough to overcome the spring tension holding the armature contacts away from the stationary contacts. It then allows the contact points to close. The circuit is then completed between the generator and the battery. The current flowing from the generator to the battery passes through the series winding in the right direction, which adds to the magnetism holding the armature with the contacts in a closed position.

**Reverse current cutout . . .** Current begins to flow from the battery to the generator when the generator slows to a speed insufficient to produce current. This reverses the direction of current flow through the series winding, thereby causing a magnetic-field reversal of the winding. The shunt-winding magnetic field does not reverse. Therefore, instead of assisting each other, the two windings magnetically oppose. The resulting magnetic field thus created it too weak to hold the contact points closed. So the spring tension overcomes the weak magnetic pull, the points open, and the circuit is broken between the battery and generator.

When the generator begins to operate, a voltage is impressed on the shunt winding, thereby causing some current to flow and creating a magnetic field. Generator voltage also closes the cutout-relay contacts as explained above.

Closing these contacts allows current to flow through the heavy series winding, thus creating an additional magnetic field. The combined magnetic strength of these two fields is enough to overcome the armature spring tension, so the contact points open.

This action diverts the field current through a wire-wound resistor which is in the circuit to the battery and generator. The resistance thus added to the field circuit causes the generator voltage and output to drop. As soon as this occurs, the combined magnetic field of the shunt and series winding is weakened, and the armature spring tension closes the contacts. The output and voltage of the generator immediately increases, the combined magnetic field strengthens, and the contact points reopen. As long as the generator and regulator are in operation, this cycle is repeated, rapidly and continuously, thereby effecting the necessary control of the output and voltage of the generator.

The field current winding mentioned earlier can be designated as an accelerator winding that speeds up the movement of the regulator armature in opening and closing the points. Field current flows through the series-field winding when the contacts are closed, thus creating a small magnetic field. When the strength of this magnetic field is added to that of the shunt winding, it helps attract the armature. This causes the points to open. Current ceases flowing through the field winding and its magnetic field collapses. This causes an appreciable weakening of the total field magnetic strength holding the points open. The armature spring tension then closes the points quickly. An increased rate of armature vibration is the result.

**Temperature compensation . . .** The resistance of the regulator windings is lower when they are cold than when they are thoroughly warmed up. Therefore, the voltage needed to force a certain amount of current through the windings also varies. Ordinarily, this condition would allow the regulator to operator at a much higher voltage when hot than when cold. But the combined current-voltage regulator used by Texas Gas has a temperature-compensating device built into it.

This device is a bimetal hinge attached to the regulator armature. It provides increased spring tension when the regulator is cold and less tension when the regulator is hot. This action eliminates the effects of changing electrical resistance with changing temperatures.

During the first few minutes of operation, while the regulator is warming up, the temperature compensation does not produce a uniform drop in the charging voltage. The voltage may go up slightly before it begins to drop because the different internal parts of the regulator heat up at different rate. Usually, about 15 minutes are required for the regulator to reach a normal or stable operating temperature where stable voltage and current readings can be obtained.

**Explosion hazard voided . . .** To prevent the arc created by the opening and closing of the regulator contacts from igniting explosive gases that might be in the surrounding atmosphere, the regulator is mounted in an explosionproof condulet. In the right center of Fig. 2 is the condulet in which the regulator is enclosed and its relative location in the system. Fig. 3 is a wiring diagram of the entire system. Of particular important is the part showing wires being connected directly to the regulator body for ground-connection elimination.

### Battery Installation

The 12-volt battery employed in the ignition system is currently being used in several well-known makes of pas-

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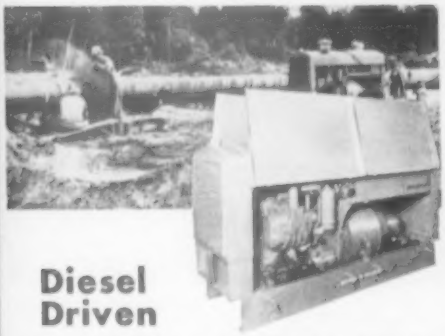

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*. . . many refiners are still trying to catch up . . .*

# About your top octanes . . .

## *Refinery Consultant Melvin Gertz answers your questions about the industry's hottest subject*

As a service to the refining industry, Ethyl Corporation asked Refinery Process Consultant Melvin Gertz* what can be done to control the increasing cost of top octanes! Here is the interview:

**Q.** *Are we approaching the end of our present cycle of refinery expansion and modernization?*

**A.** No. Many refiners are still trying to catch up with the demand for petroleum products. At the same time, two problems have necessitated more building: (1) a leveling out in the market for heavy fuel oil, and (2) octanes have steadily increased.

**Q.** *How is the industry solving these two problems?*

**A.** Refiners have accomplished the reduction in fuel-oil yield by installing new cat crackers, increasing coking installations and expanding asphalt production facilities. And fortunately, the addition of cat crackers has also considerably helped in meeting the demand for higher octanes.

However, octane increases have made refiners look to other processes and so that's why we have witnessed a wave of catalytic reforming installations over the past few years.

**Q.** *What would you say is the major problem that refiners are trying to meet?*

**A.** Certainly, today, the major emphasis is on filling the need for higher octane fuels.

**Q.** *Is expansion planning more difficult for the refiner today than, say, ten years ago?*

**A.** Yes, it is. Although we now have more processes to choose from and our technology for dealing with problems has improved, the industry has reached the octane level where each step requires careful analysis. Moving above the 98 octane level into the 100 plus octane range is expensive, no matter how you do it, and, in some instances, the end products are quite different.

**Q.** *In your opinion, what processes should a refiner consider in the 98 to 100 plus octane range?*

**A.** High-severity catalytic reforming, alkylation, isomerization—and combination processes such as catalytic reforming followed by extraction and thermal reforming. All of these processes have their own merits, and in a given refinery each would result in a different combination of gasoline yields and octane ratings.

**Q.** *Even with the differences in processes, isn't the problem still a matter of finding the cheapest way to produce 100 plus octane gasoline?*

**A.** No. It just isn't that simple. In some of the newer cars, the engines are relatively mild so that the road octane rating very closely follows the research octane rating. But for many of the new cars, there's some depreciation in road performance below the research rating.

Therefore, in planning octane improvement processes for the future, much consideration must be given to

*. . . each step requires careful analysis.*

*A partner of Purvin & Gertz, Dallas, Texas.

hydrocarbon composition and performance in vehicles as well as to the primary objective of ratings made in the laboratory.

**Q.** *Are there any other factors in process selection?*

**A.** Yes. The next factor to be considered is volatility. In some companies there is a definite trend to high volatility gasoline which necessitates removal of many higher-boiling-point top-octane components such as polymer gasoline and heavy cat naphtha from the premium blends. If this trend continues, it will have a significant effect on the selection of future processes. In other words, in addition to merely research octane ratings which have been the primary yardstick for the past few years, economic considerations at this time must be weighed

*Moving above the 98 octane level into the 100 plus octane range is expensive . . .*

in the light of either present or future importance of such factors as road rating and volatility.

**Q.** *Don't these various factors depend to a great extent on what automobile manufacturers will be doing for the next ten years in engine design?*

**A.** That's true and I feel a coordination of effort between the petroleum and automotive industries is of extreme importance at this time. Otherwise, refiners will be hard pressed to make a realistic decision if they are planning to modernize their plant facilities.

**Q.** *After a refiner has selected his process facilities and built his new plant, are most of his problems behind him?*

**A.** No, striking the optimum level of operation for all such facilities in a plant becomes a very complex problem. For example, when most catalytic reformers were initially installed, they operated at relatively mild severity, and further octane improvement could be achieved with relatively small incremental losses in yield. Under these conditions the cost of an incremental increase in octane expressed as cents per Research octane number barrel was frequently as cheap in the reformer as it would have been with the use of increased lead. However, with the increased severity demand from cat reformers today, it is generally advantageous to use rather high concentrations of lead.

*The optimum combination of severity and lead concentration is . . .*

The optimum combination of severity and lead concentration is something that would be peculiar to each refinery, depending on the particular processing facilities and the charge stocks available. Studies of this type should be made with regularity in order to take maximum advantage

*Studies . . . should be made with regularity . . . to take maximum advantage . . .*

of the facilities available in satisfying your market requirement at any given time.


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Our Refinery Technology staff, backed up by the extensive facilities of the Ethyl Laboratories, will be glad to share their experience with your economics people when you conduct a cost analysis of your top octanes.

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senger automobiles. This battery was selected because of its durable construction and its small, compact size. The output of the battery is higher than is ordinarily required because the ignition current demand is small. But the extra capacity would operate an engine for a considerable length of time should a generator fail in service and replacement could not be made immediately.

Because a battery being charged, or having been recently charged, gives off an explosive gas, the ignition battery has to be enclosed and some method provided to remove the gas being emitted. The battery enclosure is fabricated from No. 10 gage sheet metal, and is large enough to allow easy insertion or removal of the battery. A hinged cover is attached with hinged clamps to ease access to the battery for checking purposes and maintenance. A resilient rubber gasket is used between the cover and enclosure for sealing.

The battery enclosure is mounted under the catwalk of the engine where it is out of the way and inconspicuous. At this location, it is as near to the other ignition components as possible. A view of the enclosure is shown in the top center of Fig. 2.

Removal of the explosive gas from the battery enclosure is achieved by a flow of air introduced into the enclosure and vented to the outside of the engine room. To obtain the necessary air, a hole is drilled and tapped into the scavenging-air discharge header as close as possible to the battery enclosure and an air line is installed into the battery enclosure opening.

A valve is inserted in this line to regulate the air flow and to be closed when the engine is stopped. This serves as a precautionary measure against hydrogen gas entering the air header when the engine is not operating. A check valve is recommended for this purpose. A larger vent line is installed from the enclosure to the outside of the engine room, usually ½-in. or larger, to enable the gas to escape easily.

The flow of air through the battery enclosure serves two purposes. It flushes the hydrogen gas from the enclosure and helps keep the battery cool.

A voltmeter is installed across the generator charging circuit to show whether or not the generator is operating correctly. An ammeter is installed in the ignition load circuit to indicate any change that might occur in the ignition load.

**Underground system for reversal . . .** It was previously mentioned that an insulated regulator and generator were used in the system and that a reason for using them would be given.

As mentioned earlier, Texas Gas found that the reversal of the ignition current would prolong the life of contact points and spark plugs. So it was desirable to continue the use of this feature in conjunction with the generator-regulator-battery combination installation. But to do so while using an ordinary grounded system would result in the reversal of the polarity of the generator and regulator, thereby causing the generator to fail to generate.

The ignition system described in this article was selected by Texas Gas for its simplicity of design and easy replacement of parts. Installation and maintenance costs are low compared to systems having a remote ignition supply. The system makes each engine self-sufficient by having its own individual packaged unit. It prevents under or overcharged batteries. It eliminates excessive voltage drop due to long battery-to-coil leads which are encountered when the source of ignition is installed at a remote location. It does away with voltage kickback in the primary circuit caused by firing of spark plugs when several engines are connected to a common source of ignition supply. And most important, it provides a very steady voltage at practically all engine speeds.

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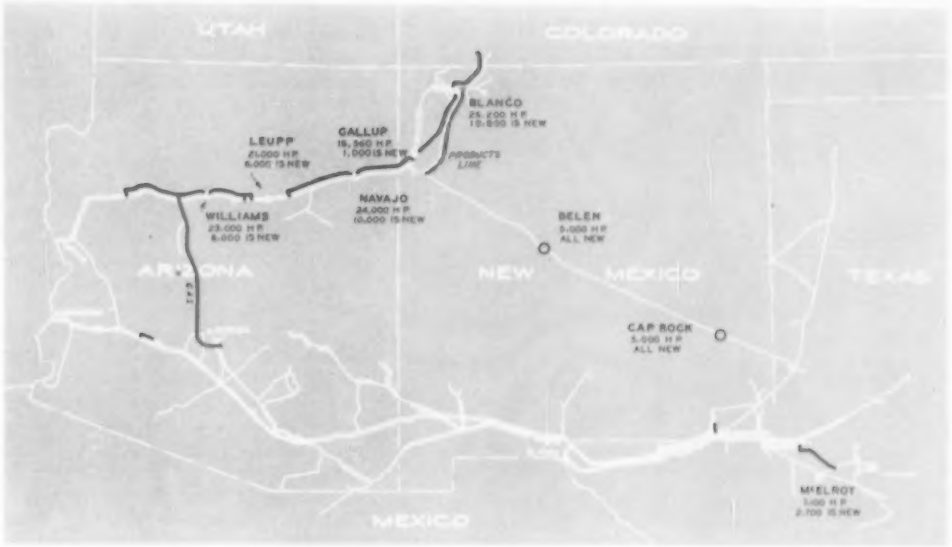


**Lines in black mark looping project. It includes 338 miles of 34-in. loop, a 149-mile 20-in. cross-connecting line, and 96-mile products line.**

# El Paso Starts Biggest Expansion Program

## Its 34-in. looping puts firm into superinch league in big way

**by Larry Resen**
District Editor

EL PASO NATURAL GAS CO. embarked on a mammoth 195-million-dollar expansion program this year which is the largest single undertaking in its history on a dollar and volume basis.

Pipeline capacity is being increased by 450 million cubic feet daily which will provide a 2.338-billion-cubic-foot daily delivery capacity in the company's interstate transmission system. In the project, 55,500 compressor horsepower will be added which will give the company a total of 753,715 installed compressor horsepower in compressor stations.

Major pipeline additions include 149.3 miles of 20-in. line and 338.8 miles of 34-in. pipe. With the latter installation, El Paso will enter the superinch league in a big way. Capacity of the Blanco absorption plant and Wingate fractionating plant will be approximately doubled.

**Bird's-eye view . . .** A quick rundown on system expansion is as follows:

1. A total of 338 miles of 34-in. line will be installed as loops between the Blanco plant near Farmington, N. M., and Topock on the Arizona-California border. Generally, the loops will parallel existing 24 and 30-in. lines across northern Arizona. Three major sections of 34-in. will be laid. These are a 70.9-mile stretch from the Blanco plant to the Gallup, N. M., station; a 122.2-mile run from near the Gallup station to Leupp, Ariz.; and a 127.1-mile length from a point several miles east of Flagstaff, to a point several miles east of Kingman, Ariz. A short 18.6-mile run from Franconia, Ariz., to Topock will complete the 34-in. projects.

2. A 149.3-mile 20-in. line will run from Chandler, southeast of Phoenix, and tie into the 34-in. line near Ashfork, Ariz.

3. Miscellaneous pipeline additions include a 34.1-mile, 24-in. line between the Blanco plant and Pacific Northwest Pipeline Corp.'s Ignacio, Colo., plant in Southwest Colorado; a 16.2-mile 30-in. loop near Gila station in Arizona; a 34.0-mile 20-in. line between the Sweetie Peck plants in the Permian basin and an 8.4-mile 20-in. line between Jal No. 1 and Jal No. 2 plants in Lea County, New Mexico.

4. At the Blanco plant location in San Juan County, New Mexico, a second gas-absorption plant with an inlet design capacity of 283,000 M.c.f. per day will be installed. Fractionation of all liquid products recovered there is done at the Wingate fractionating plant in McKinley County, New Mexico. A 96-mile 8-in. line will be installed to carry absorption products to Wingate. Additional fractionating equipment will be installed at Wingate to recover 258,000 gal. per day of liquids. This is in addition to the facilities already installed for fractionating 277,000 gal.

5. A total of 55,500 compressor horsepower will be installed. This will be broken down as follows:

(a) At the Williams compressor station, Cocinino County, Arizona, a total of 8,000 hp. will be installed for a total station rating of 23,000.

(b) At Leupp station, Cocinino County, 8,000 hp. will be installed for a total of 21,000. Four 2,000-hp. units will be used.

(c) At Navajo station, Apache County, Arizona, 10,000 hp. will be added to the 14,000 presently installed. This horsepower will consist of five units rated at 2,000 each.

(d) At Gallup station on the San Juan mainline, 6,000 hp. will be added to the 10,560 presently installed. This will be in the form of three units of 2,000 hp. each.

(e) At Blanco compressor station, 10,800 hp. will be added to the 15,400 presently in operation. This will

## How to cross a river . . .

**SAN JUAN CROSSING was made using dry-land methods by diverting river from its normal channel with small dams.**

**PIPE WAS LAID almost to water's edge, then the river diverted over newly laid pipe while new section of line was laid.**

consist of eight units rated at 1,350 hp.

(f) On the existing 30-in. line between the Plains and Gallup stations two new gas-turbine-driven centrifugal compressor stations will be built. These stations, known as the Caprock and Belen stations, will have one 5,000-hp. gas turbine driving a centrifugal compressor.

(g) In the Permian basin area, there are relatively minor additions of horsepower. At the existing McElroy-Crane station in Crane County, Texas, two units, rated at 1,350 hp. each, will be installed. In addition, purification and dehydration-plant facilities at McElroy will be increased by 12,700 M.c.f. per day.

**Gas supplies . . .** Various sources will supply gas for movement through the new installations. In the San Juan basin 250 million feet will be obtained from El Paso's owned reserves and purchases from other operators. The Permian basin of southeastern New Mexico and West Texas will provide 100 million feet. In addition, 50 million will be obtained from Pacific Northwest near the Canadian border and traded back for a like amount to be livered in the San Juan basin. Ultimately, it's believed the remaining 50 million cubic feet will be produced from the Pinedale structure in Wyoming, currently being developed by El Paso. This is in the early stages of development and this amount of gas will currently be drawn from other sources of supply.

**Construction . . .** El Paso Natural spreads will lay all of the new lines with the exception of 145 miles of 34-in. running west from near Flagstaff, Ariz., and 111½ miles of 20-in. line. These have been contracted to Western Pipeline Contractors, Inc., Austin, Tex.

Generally, conventional methods are being used in laying practically all of the pipeline. Particular specifications on the 34-in. line follow, with other size lines being handled in a similar manner.

The 0.406-in.-wall-thickness, 34-in.

**ROCK SHIELD protects the heavy wall 34-in. used for the crossing. Special anchors were used every 40 ft. to hold pipe in ditch.**

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o.d. pipe is received in random 40-ft. lengths. It is being laid in a ditch 50 in. wide which is excavated to provide a 30-in. cover. Depth varies from 64 in. upward to allow for padding where cuts are made through rocky areas. Wherever rock or other undesirable material is encountered, the trench is padded with 6 in. of soil or sand and the top of the pipe is also covered with sand or soil for a depth of 6 in. before rock cover is added. In washes, stream beds, and farms, 60 in. of cover is provided except where bedrock is encountered at a lesser depth. In these instances, the ditch is dug so the top of the pipe is 12 in. below the top of the bedrock.

The line is being conventionally cleaned, primed, coated, and spirally wrapped throughout its length. All line pipe installed in underground railroad and highway crossings is double-wrapped and casing pipe and enclosures are being cleaned and primed. X-ray inspection of welds and holiday detection of coatings are being carried on as standard procedure.

For the first time, El Paso has embarked on the use of scraper traps in part of the 34-in. line to permit on-stream pigging. Hence, full-opening valves were incorporated in the design of the system. In construction of the line, purging of each section is being followed by blowing of pigs with natural gas to insure cleanliness prior to installing valves, traps, or drips.

**San Juan crossing . . .** An unusual method was used to cross the San Juan River with 34-in. line near Bloomfield, N. M. The decision was made to divert the river during crossing operations so the actual pipe laying could be done in a conventional overland manner. Existence of a thick layer of tough blue shale beneath the gravel-sand river bed cover contributed to this decision.

Pipe was first laid almost to the water's edge. Following this, a dike was constructed to divert the river from its main channel. A dam was then constructed and the water flow was directed across the area where pipe had already been laid. Equipment was next moved in and ditching operations commenced. Dozers were used to remove as much of the overburden before moving in ditching machines to work on the trench. Although it was necessary to do some drilling and shooting, it was possible to rip through the shale on a great portion of the ditch by making double runs with the ditchers. This resulted in a very smooth-walled trench through the shale bed. Rock shield was used to protect the pipe before filling the ditch.

A special anchor setup was used to prevent the pipe from floating out of the ditch. El Paso decided to use semi-circular saddles made out of ½-in. plate. Steel rods were grouted into position, one on either side of the pipe in holes which were drilled 15° from vertical. These were 1¼-in. rods, 9 ft. in length. The lower end of each was split and wedged apart to afford a better grip in the concrete. Additionally, four barbs were welded at 1-ft. intervals to provide more gripping surface. The saddles were placed on pads and fastened to the rods. Enough slack was allowed in tightening the saddles to permit horizontal movement of the pipe and still prevent vertical displacement. The anchors were used at 40-ft. intervals along the 760-ft. crossing.

In another crossing, this time of a dry wash, anchors were used to protect the pipeline against flash flood. In one particularly bad stretch, 250 of these were installed at 25-ft. intervals. There were a manufactured type also used on river crossings. The heavy force of flash-flood waters in these semiarid areas makes anchoring an especially important feature in these washes even though they contain water only a few days in the year.


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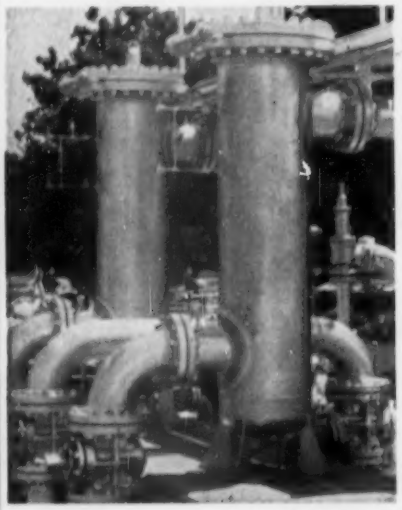

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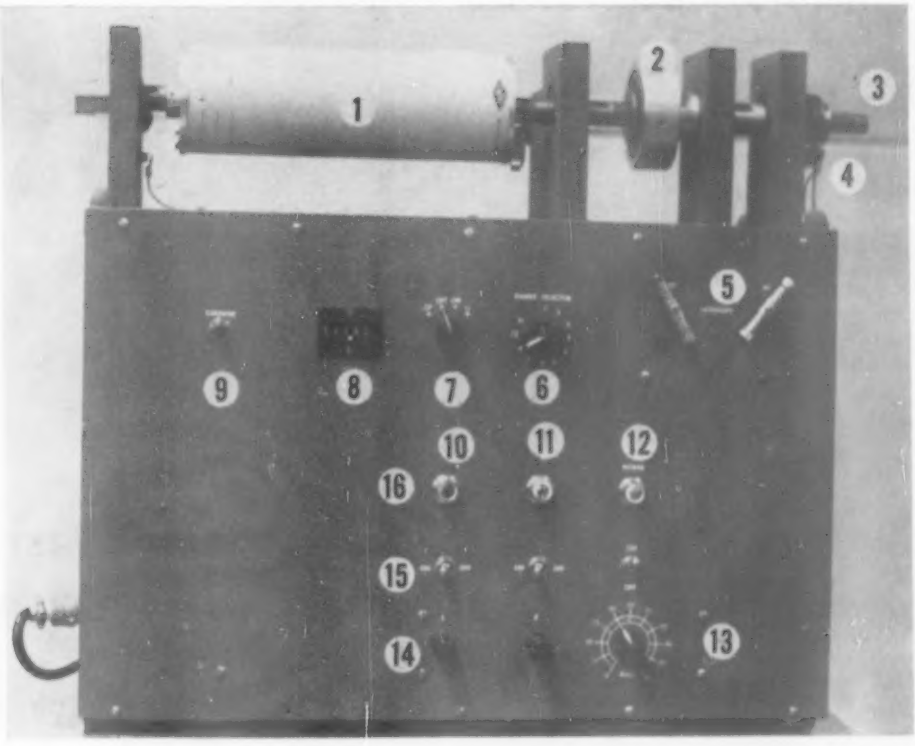


**ELECTRONIC PRESSURE INDICATOR designed for testing engines and compressors used on natural-gas pipelines. Numbers on the photograph are identified as follows:**

1. Recording drum
2. Clutch
3. Drive end of shaft
4. Counter breaker points
5. Operating valves
6. Range selector
7. Instrument control switch
8. Rev. counter
9. Counter start button
10. Trigger circuit No. 1
11. Trigger circuit No. 2
12. Power supply section
13. Sparking sensitivity control
14. Pickup lead connection
15. Trigger circuit switch
16. Trigger circuit light.

T.G.T. wanted quicker cylinder-pressure information . . . New indicator provides

# Better Test Results in Half the Time

**The electronic pressure indicator described here was designed especially for testing engines and compressors used on natural-gas pipelines. Its use reduces test time more than 50 per cent and gives more reliable results than those obtained with previous instruments.**

**by Thomas L. Novasad**

BECAUSE of the need for a faster means of measuring compressor cylinder pressures, Tennessee Gas Transmission Co.'s research department has developed an electronic performance indicator. Test time on compressors is reduced more than 50 per cent by recording several pressure diagrams simultaneously. Results are more reliable and there is less wear and tear on the test engineer.

Pressure scales on the instrument may be changed quickly by turning a switch and a sensitive scale allows taking of expanded diagrams at high pressures. This is useful when making detailed studies of pressure waves.

The balanced diaphragm pressure indicator has been recognized as being very accurate. It works on the principle of balancing an unknown pressure against a known reference pressure in a small pressure cell. A thin flexible diaphragm either makes or breaks an electrical contact at the instant of balance depending on whether the pressure is rising or falling.[1]

To complete the indicator so that an engine or compressor pressure cycle or any other recurrent cycle may be developed, the piston position or engine crank angle must be found at the instant of pressure balance. This may be done manually or automatically.

**Previous methods . . .** The manual method requires data to be recorded point by point. The reference pressure is static during the observation of data. As much as 45 minutes is required to develop a diagram. Accuracy is very good, provided that the operating pressures remain stable during the period of test. This is the first type of indicator used by T.G.T. It was used about 2 years. In 1949 an instrument based on the automatic method was purchased. In this instrument a diagram is recorded on a rotating drum directly coupled to the engine flywheel. The process takes about 5 minutes.

The recorded diagram may be easily replotted to the pressure-volume type for horsepower, compressor delivery, and other calculations. One mechanical replotter has been purchased, and another designed and constructed by this laboratory.

Tennessee Gas has carried on an active program of performance-testing its compressor units since 1949. The balanced-diaphragm pressure indicator has been the backbone of this work. In general, the information gained is used to increase operation efficiency and as a help in selecting new equipment.[2,3] Figs. 1, 2, and 3 illustrate the progress

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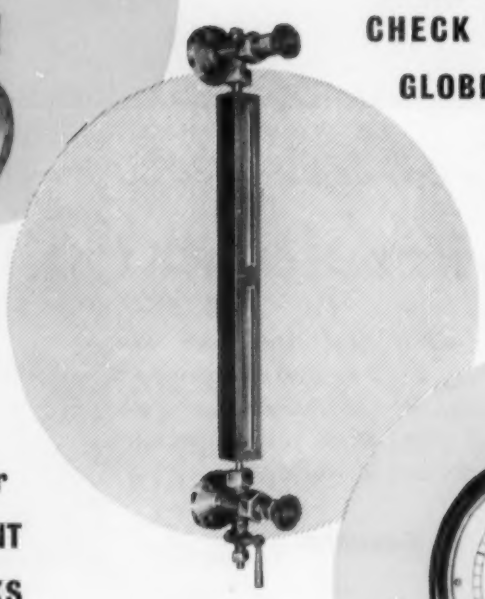

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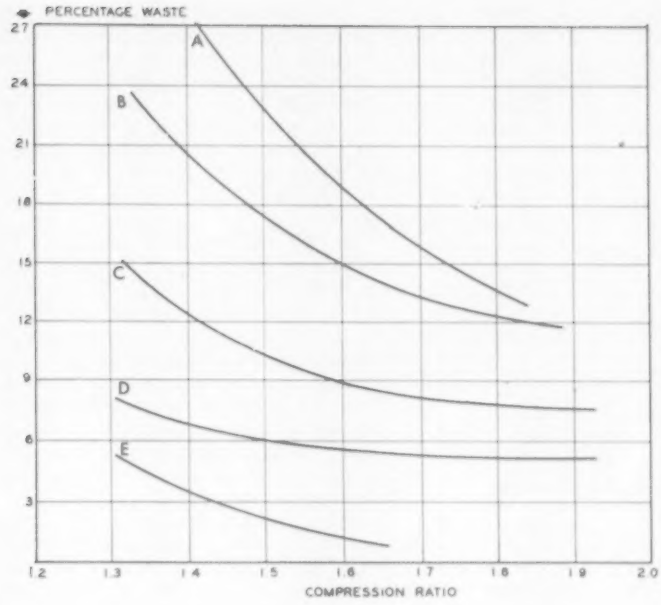
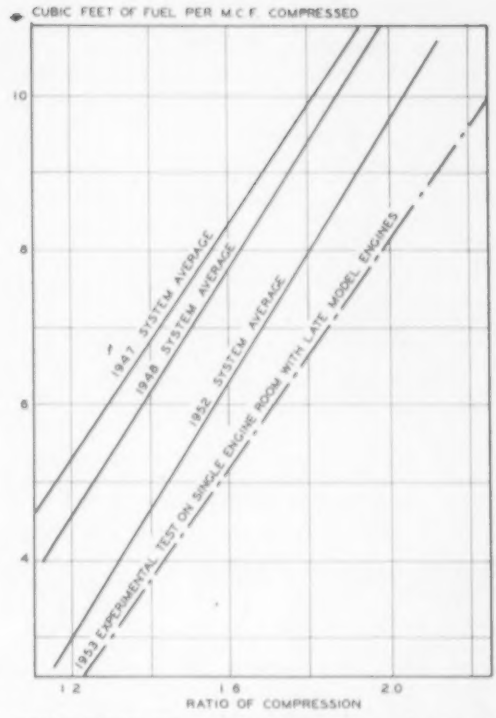



**COMPOSITE WASTE CURVES for five compressor cylinders. Fig. 1.**

| Curve | Bore size, in. | No. valves per end | Per cent clearance | Valve lift area, sq. in. | Valve velocity, feet per second |
|---|---|---|---|---|---|
| A | 7½ | 2 | 9.5 | 5.51 | 2,415 |
| B | 7½ | 2 | 11.3 | 5.893 | 2,415 |
| C | 10 | 4 | 14.2 | 9.32 | 2,227 |
| D | 8¾ | 4 | 20.2 | 9.32 | 1,681 |
| E | 13¼ | 4 | 59.4 | 26.11 | 1,088 |




**COMPRESSOR FUEL CONSUMPTION as a function of compression ratio. Fig. 3.**

## Natural Gas—Gas Pipelines

made in operating efficiency and loading ability of the units. Throughout this period of progress the indicator has been able to chart the course.

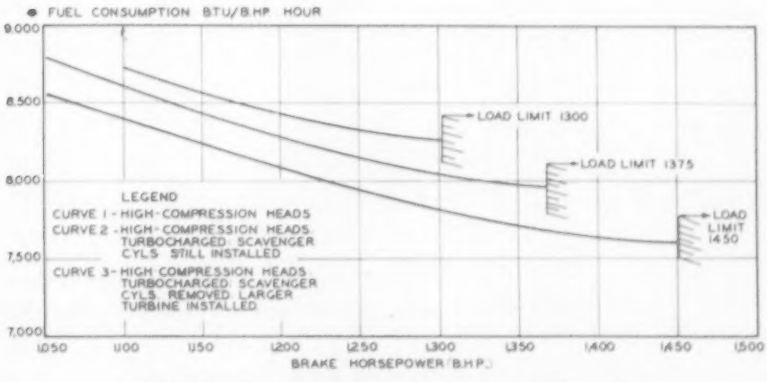
For example, Fig. 1 shows the decrease in compressor waste horsepower obtained by decreasing valve velocity. Fig. 2 shows the increased fuel economy and loading ability of one type of engine as various improvements were made. Fig. 3 reflects the effect of decreased compressor losses and increased fuel economy on the operation of the entire system. This is expressed as cubic feet of fuel used per M.c.f. gas compressed plotted against compression ratio.

The total horsepower now operated on the system is over 500,000. This means that small gains in efficiency and loading ability are very valuable dollarwise. It is reasonable to suppose that the indicator should be credited with a percentage of the improvements noted.

**Faster recorder needed** . . . Much of the test work has been done with the above-described balanced-diaphragm instruments. When used under the proper conditions and care, most reliable results were obtained with them. The use of these indicators, however, brought out the need for certain improvements.

One instrument took as much as 45 minutes to record a diagram; the other, at least 5 minutes. More rapid means of recording was needed. Stability of pipeline pressures during a test run cannot be depended upon due to unexpected events. An example is the pressure changes received when compressor units are added or dropped to maintain the requirements of the dispatcher. To decrease these probabilities, indicating should be as rapid as possible.

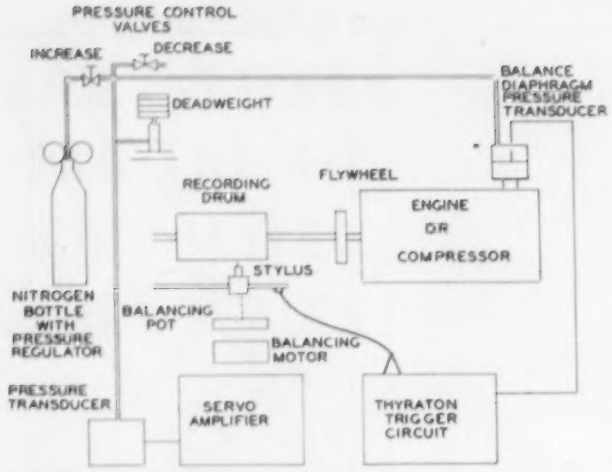
Another improvement needed was the




**CHARACTERISTIC FUEL CURVE for pipeline engines. Fig. 2.**

**THE AUTHOR**

**Thomas L. Novasad, research engineer for Tennessee Gas Transmission Co., Houston, has been employed by the company for 9 years. During this period he spent 3 years in the operating department, and the past 6 years in the research department. He is a member of the A.S.M.E. He graduated from University of Texas in 1947 with a degree in electrical engineering.**




**WORKING PRINCIPLE for the test system showing engine or compressor connections with various parts of the indicator circuit. Fig. 4.**

## Natural Gas—Gas Pipelines

ability for the indicator to take expanded scale diagrams at elevated pressures. This feature would be useful in detailed study of pressure waves. Also, diagrams of low pressure ratio could be expanded. The power loss due to compressor valves could be more easily determined. A top center pickup that would be installed directly on the engine was also needed.

Top center was timed in the older instruments by adjusting the coupling shaft or positioning a set of breaker points operated by a cam on the drum shaft. The accurate recording of top center is very important and direct determination would decrease any possibility of error. Although a tachometer is not thought of as part of an engine indicator, measurements of engine speed during the indicating period is always necessary. It was thought that a built-in tachometer would be a convenient addition to the indicator.

When it was decided to attempt construction of an instrument containing the features mentioned above, it was realized that they could be attained by several methods. It was decided that the simplest system that would allow the use of sensitive pressure scales at elevated pressures would be an electromechanical servo loop using a strain-gage pressure transducer, servo amplifier, balancing motor, and potentiometer. Also, at this time a thyration trigger circuit to produce the recording spark was developed which would record several pressure traces from the same stylus simultaneously.

An experimental unit was immediately built and installed in the older indicator. Design and construction of the new instrument were started by Norvel Lee Miller. It was completed and tested by Paul A. Wade and Muriel W. Moore. All men engaged in the work were of the T.G.T. research department.

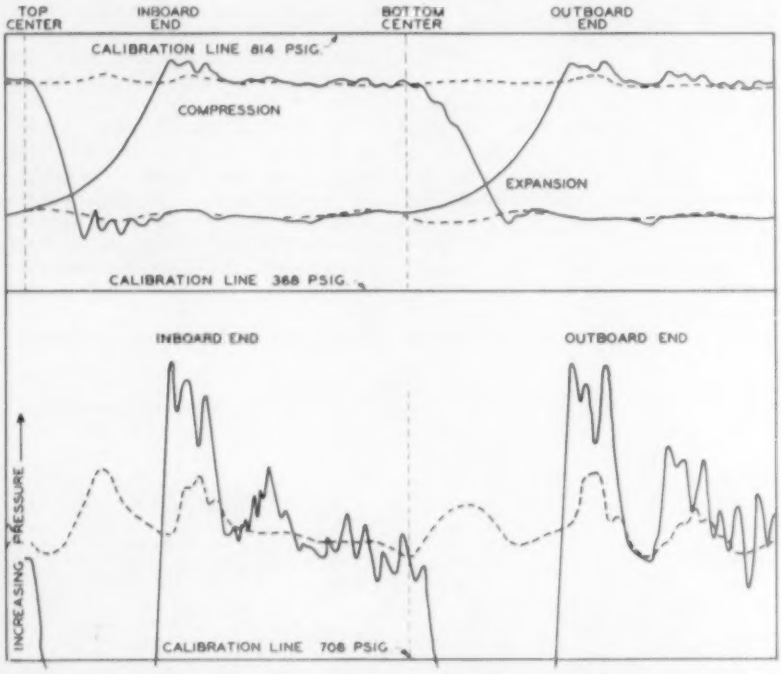
**Working principle . . .** The principle of operation of the whole system can best be understood by referring to the sketch shown in Fig. 4. To simplify the explanation a constant reference pressure set at some value in the range of operation of the machine to be tested is assumed.

The recording stylus is driven to some position on the recording drum as a function of the reference pressure and scale setting. This is accomplished by the closed servo loop consisting of a Brown servo amplifier, balancing motor, balancing potentiometer, strain-gage-type pressure transducer. A cable system moves the stylus to its proper position.

Briefly the reference pressure will unbalance the resistance bridge in the pressure transducer. This causes the servo amplifier to run the balancing motor. It turns the balancing potentiometer to a position which corrects the resistance unbalance in the pressure cell. By means of a cable and pulleys, the stylus is driven from the balancing motor shaft to a position representing a measure of the amount of reference pressure on the system.

When the pressure, rising or falling, in the machine being tested becomes equal to the reference pressure the balanced pressure diaphragm makes or breaks contact. This energizes the trigger circuit and a spark is produced at the stylus.

By slowing raising or lowering the reference pressure through the pressure range of the equipment being tested a diagram of pressure versus crank angle will be developed as shown in Fig. 5. The present instrument incorporates a trigger circuit which will record from two balanced-diaphragm pressure pick-




**TYPICAL PERFORMANCE CURVE (upper diagram) made with instrument using coarse pressure scale. Dotted lines are pressures taken on risers from and to suction and discharge bottles. Fig. 5.**

**LOWER DIAGRAM is a magnified portion of Fig. 5. This enlarged pressure diagram allows detailed analysis of cylinder performance. Fig. 6.**

ups. This is done from the same stylus. One unit has been built which will record four individual traces.

Since the usual procedure in compressor testing is to superimpose pressure waves on the same scale, the identification of four traces was difficult and it was considered impractical to operate this many circuits. However, with two circuits, usual test time is decreased more than 50 per cent.

**Engine speed . . .** The built-in tachometer is of the electromagnetic counter type. The count is taken from breaker points mounted on the drum shaft. The counting period is for 1 minute giving the revolutions per minute directly.

The indicator is directly coupled to the engine through a 10-in. length of steel cable which is rigid enough to prevent whipping, yet has the required flexibility to absorb any misalignment of centers or angularity. The engine end of the shatf is equipped with an octagon-shaped pin such as to fit into a like socket mounted in the center of the flywheel.

The positive system of recording top center of one of the engine or compressor pistons is done by a magnetic reluctance pickup which senses a small drilled hole in the revolving flywheel. The hole and pickup are lined up at a point which causes an electrical pulse when the reference piston has reached its top center position. The pulse is amplified and fed into the trigger circuit. By turning the instrument control switch to "TC" position and raising that reference pressure, a top center line is drawn on the diagram.

In general the instrument is operated as any other of this type. A pump may be used to create reference pressure, however, nitrogen is generally used as it is inert and thought to decrease fire and explosion hazard.

**Results of use . . .** This instrument has been used in numerous performance tests on engines and compressors. It has received the usual rough treatment of being carried many miles in an automobile.

The usual pressure scale used for compressor and engine testing is the 150 psi. per inch. Drift has not been a problem; however, a deadweighted calibration line is included on each diagram in the usual test procedure. This is thought to be good practice, regardless of instrument, and establishes confidence in the test data.

An illustration of the usual type of compressor indicator diagram recorded is shown in Fig. 5. The pressure scale was 150 psi.. Recording was started at atmospheric pressure.

Fig. 6 shows a recording of the upper pressure level in the same compressor shortly after the diagram in Fig. 5 was taken. The instrument was set at a sensitive pressure scale of 20 psi. Recording started at about 700 psig. The variations in the discharge pressure wave can now be clearly shown. Also, the pressure difference between cylinder diagram and discharge pressure wave is more apparent.

The sawtooth oscillations seen in the discharge portion of the cylinder diagram are due resonance of the gas in the long channel between the diaphragm and compressor cylinder proper. Indicating with sensitive instruments of this type will require methods to eliminate these effects. T.G.T. has developed a balanced-diaphragm pressure transducer which extends to the bottom of this channel, solving this problem.

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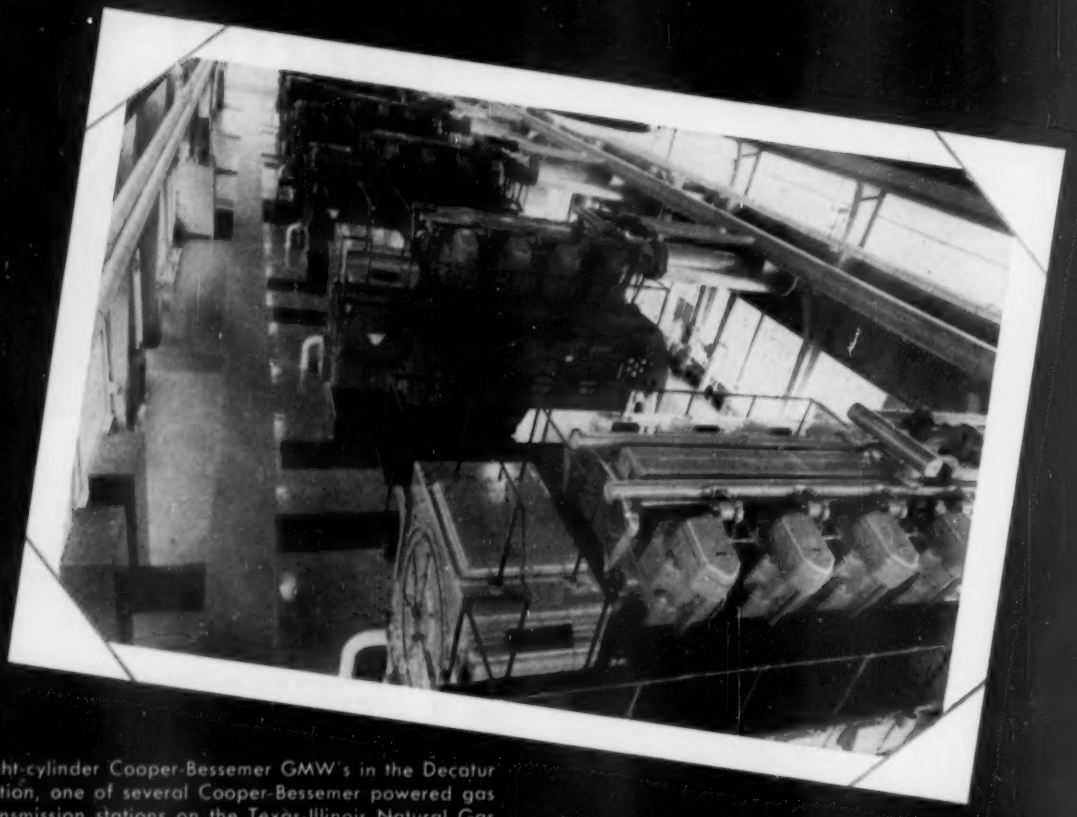

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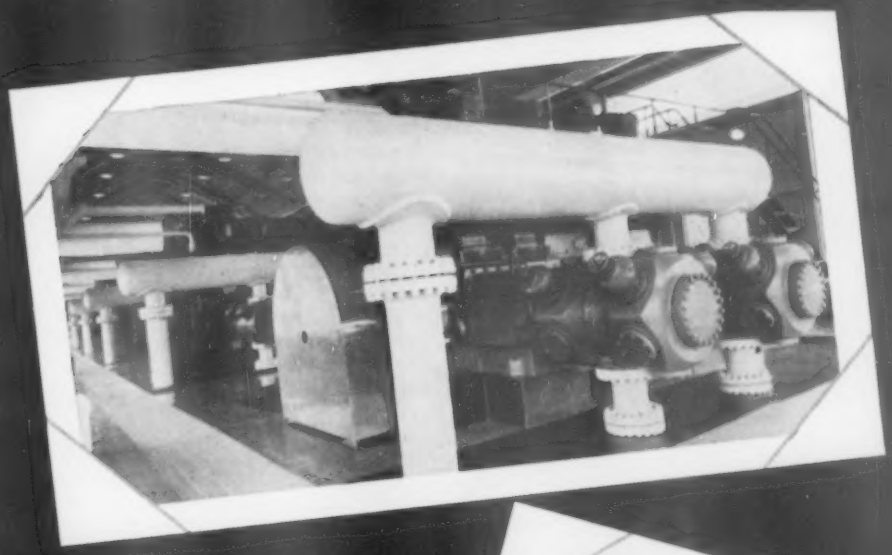

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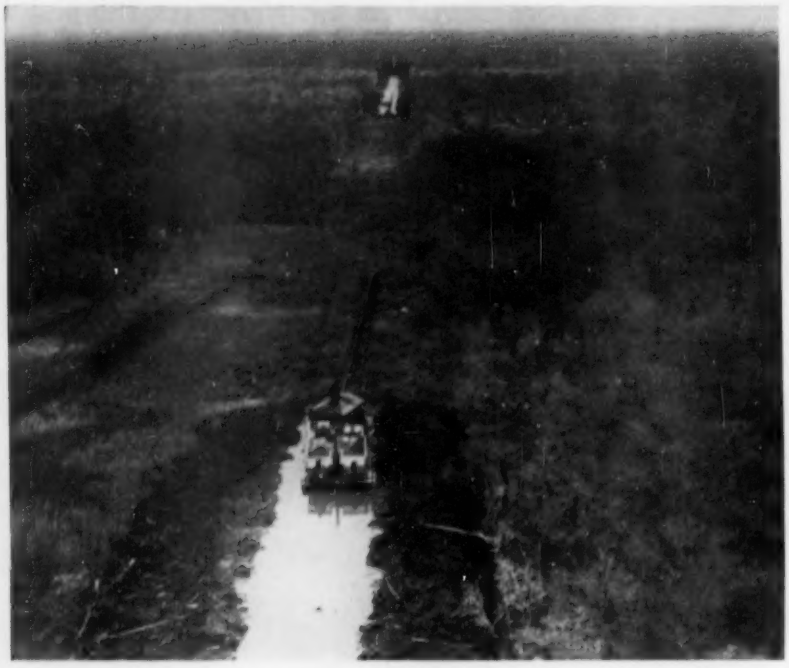

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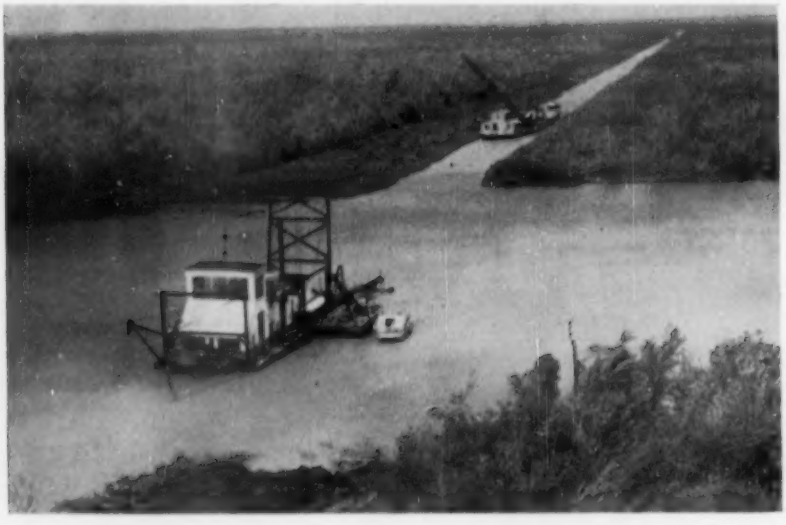


# T.G.T. Muskrat Line R.O.W.

South Louisiana coastal line provides gathering facilities for offshore and onshore fields. Eighty per cent of line lies underwater.

**by Larry F. Resen**
District Editor

TENNESSEE GAS TRANSMISSION CO. embarked on a coastal Louisiana construction program this year which will give it a network of lines capable of serving onshore and offshore fields.

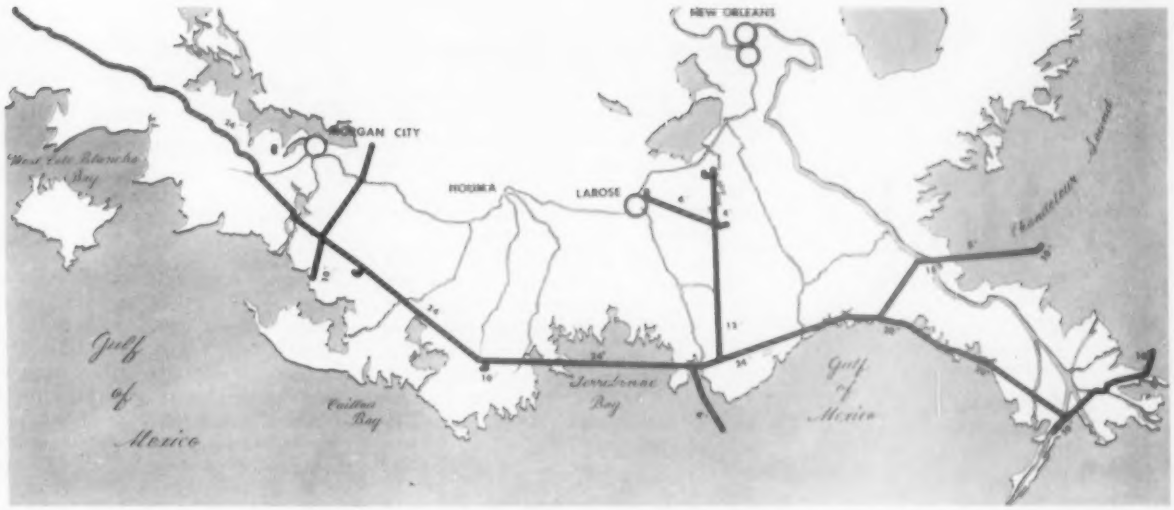
Coupled with existing facilities, this latest addition will give T.G.T. a coastal system along the entire Gulf Coast from South Texas to the tip of southern Louisiana, downstream from New Orleans.

Dubbed the "Muskrat line" *(The Oil and Gas Journal, April 2, 1956, page 76)* the new line will traverse swamps, bays, and marshland for 80 per cent of its 355 miles of installations. A few short extensions will also be made to serve offshore fields fairly close to the Louisiana mainland.

Pipe size ranges from 4 to 24 in., with the main line consisting of 193.4 miles of 24-in. and 31.52 miles of 20-in. This runs from a point near Dixon Bay in the south pass area of the Mississippi Delta to near Crowley. The system will be tied into existing facilities there and the gas moved on into the Kinder compressor station for injection into T.G.T.'s 30-in. line running north from there. Other portions of the Muskrat line include laterals from the main line to major field areas in South Louisiana. These vary in length and size. Most significant among these are three offshore laterals; a 28-mile 18 to 8⅝-in. line to Main Pass Block 35 (about half of this is in open water), an 18-mile 10¾-in. line to Main Pass Block 69, and an 11-mile 6⅝-in. line to Bay Marchand field.

The major portion of the route brought up the variety of construction problems attendant to submerged crossings. Thus, practically all of the pipe is being laid from barges operating in canals dredged along the right-of-way. The entire right-of-way through the marshes is being dredged out to provide a 40-ft.-wide canal with a depth of 8 ft. Pipe is being laid in a 4-ft. trench dug at the bottom of the canals. Once the pipe has been laid and covered in the trench, the canal will be dammed at each intersecting bay or waterway to prevent changing the channel flow, to guard against erosion, and to prevent salt-water intrusion into the marshes. Upon completion of the line access to the right-of-way will be by seaplane, except for three points.

The very terrain which presents the problems, however, also contributes to the transportation solution. South Louisiana is interlaced with a network of canals and bayous. This, along with the natural advantages of the Mississippi and Atchafalaya rivers, means that all equipment and supplies can be barged into the right-of-way canals from convenient supply points.




**MOST OF MUSKRAT RIGHT-OF-WAY consists of 40-ft. wide canals dredged to a depth of 8 ft. through the marshes. Line makes 130 crossings of navigable waterways.**

## Natural Gas—Gas Pipelines

Pipe-coating yards are set up at strategic locations at Morgan City, La-Rose, New Orleans, and Harvey. All of these sites are connected via barge routes to the right-of-way canals. Concrete-weighted joints are loaded on barges from these yards and the barges routed through the waterways to the most convenient point on the right-of-way. The numerous barge routes available make it possible to enter the right-of-way or cross it at about 20 different points. The greatest distance between any two of these access points is about 28 miles, meaning the farthest any one barge has to travel after entering a right-of-way canal is 14 miles.

**Pipe coating . . .** Negative buoyancy of the pipe is being attained by concrete-coating the joints following regular coating and wrapping operations.

**DITCH DEPTH is checked by man on line while others prepare concrete for finishing field joints.**

**HELICOPTERS provide fast courier service over the marshes; this one landed on a barge load of pipe.**

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In standard procedures in the various yards, the pipe is first cleaned and then a coal-tar primer coat applied. A 3/32-in. modified coal-tar enamel is added and a fiber-glass mat wrapped into the coating. This is followed by a second 3/32-in. modified coal-tar enamel coating and a 15-lb. perforated asbestos felt wrap. Finally, a 2½-in.-thick coat of concrete is applied including 1½-in., 17-gage wire-mesh reinforcement. Field joints are wrapped with polyvinylchloride tape before coating with concrete.

**Valve stations . . .** Platforms supported on piling are being used for the various valve stations along the water portion of the line. These stations vary in size according to whether or not they have scraper traps and the number of lateral tie-ins, if any. Two of the larger type platforms are typical and measure 22 by 45 ft. and 38 by 39 ft. On the smaller-size platform, an 18-in. lateral joins the main line and only one scraper trap is included.

The second station has just the incoming and out going mainline, but is equipped with two scraper traps. This accounts for the square layout as opposed to the rectangular plan in the foregoing case. Each station is equipped with walkways and ladders for accommodation of personnel who will operate the valves. No compressor stations are included on the line. Gas producers will furnish gas at 1,000 psi. and furnish their own pressuring facilities.

**"The Muskrat line is part of a 56-million-dollar expansion program which includes increased horsepower at the Kinder, La., station and three new stations—"**

**River crossings . . .** Route of the line takes it across 130 navigable bodies of water. With so much of the line passing over wet terrain, these various streams, bays, and rivers do not pose any particular problems except at the Mississippi River. Two crossing locations have been taken into consideration there. A hydrographic study of the preferred crossing site showed the east bank of the river had been continually caving for years and would probably continue doing so. Hence the crossing point has been relocated.

U. S. Corps of Engineers specifications require that immediately after crossing the levee, the pipelines head downward at a sharp angle. The trench will be located about 90 ft. below water level within 650 ft. of crossing the levee.

A different problem is faced farther downstream in the delta area. Here, the river splits into several fingers, or passes, and fans on out into the Gulf of Mexico. Several of these passes will be crossed. To keep the river from channeling into the pipeline right-of-way and trenches, these crossings will be made so that the first 1,000 ft. on either side of the crossings the pipe will be held to a maximum 1-ft. depth.

The Muskrat line is part of a 56-million-dollar expansion program which includes increased horsepower at the Kinder, La., station and new stations at Extension, La., New Albany, Miss., and Findley Lake, N. Y. Also included are 221 miles of 30-in. and 26-in. mainline loops in Kentucky and Ohio.

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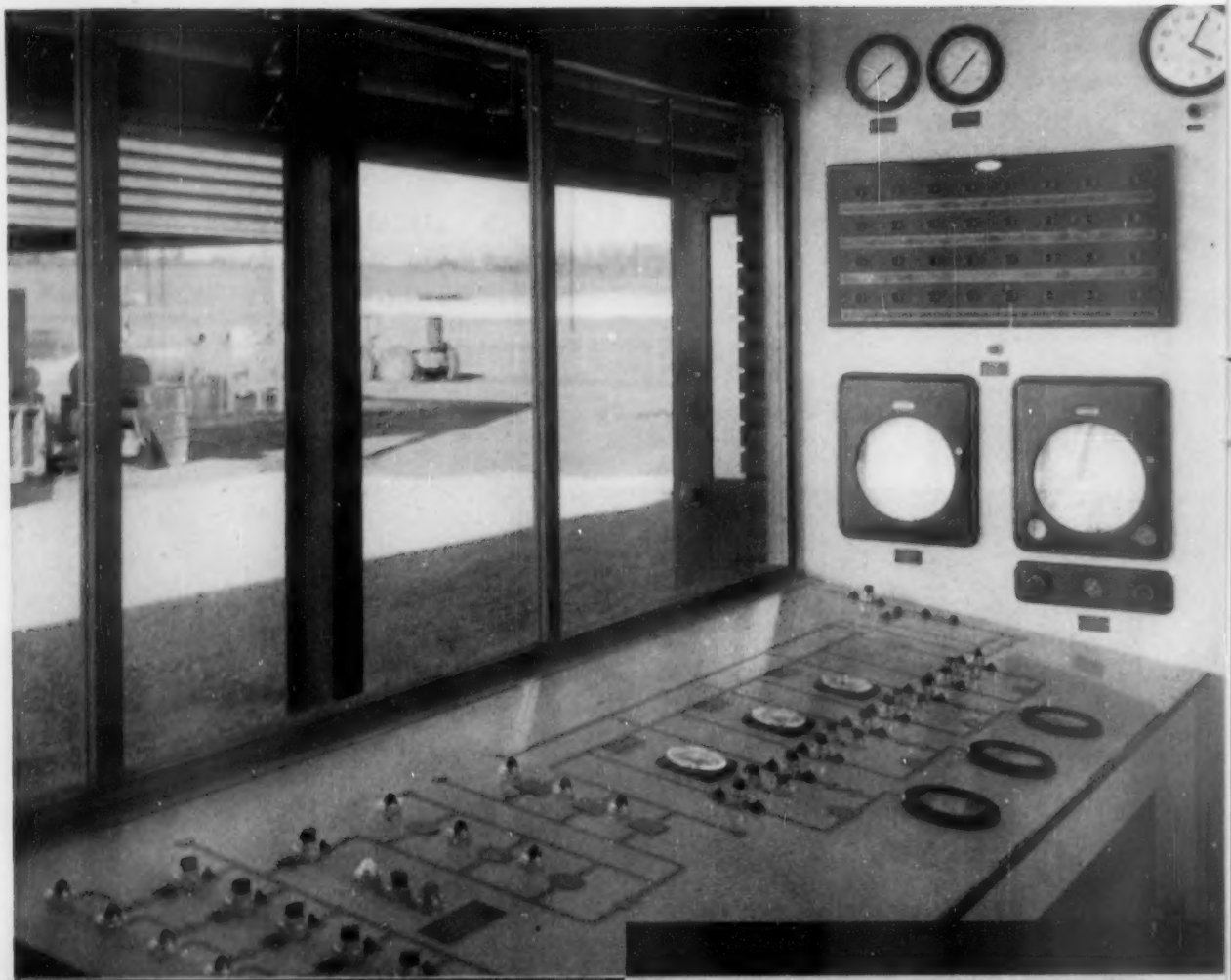
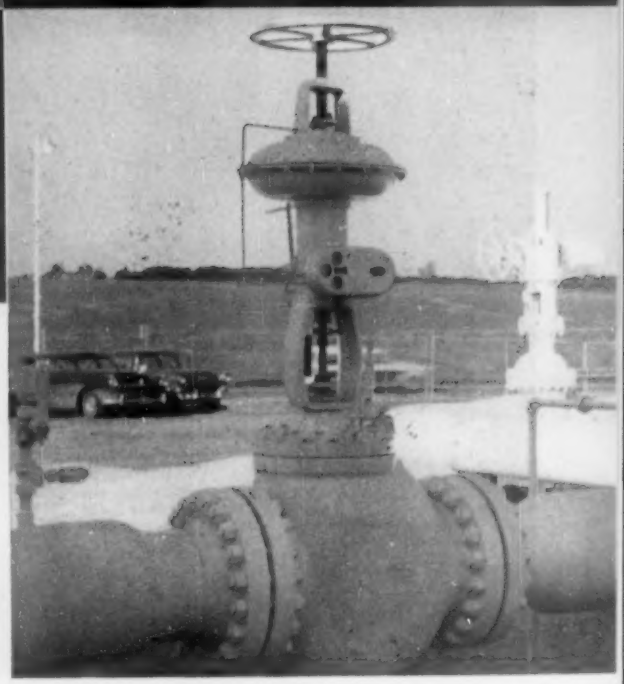


The control room at Watson, California, the first station on the Western Branch. On the panel at the right is a Masoneilan 60000 Series Dual Selector Controller, with manual subpanel, and a Pressure Recorder. All controllers and auxiliary instruments for all stations were supplied by Mason-Neilan.



One of 15 Masoneilan 10000 Series Control Valves installed on the new pipeline. This one is a main line valve equipped with a Series 7400 Positioner for accurate, positive positioning.

# Masoneilan Controls Assure Dependable Performance of 846 Miles of S. P. Pipeline

All pumping and take-off stations on the new Southern Pacific petroleum products pipeline are completely equipped with Masoneilan Controls. The control systems were engineered by Mason-Neilan, working in close cooperation with Engineering Management, Inc., to provide accurate performance and year-round dependability.

This combination of engineering experience and high quality product assures Southern Pacific of years of satisfactory, economical operation with minimum maintenance — an assurance backed up by successful installations on many other pipelines in this country and abroad.

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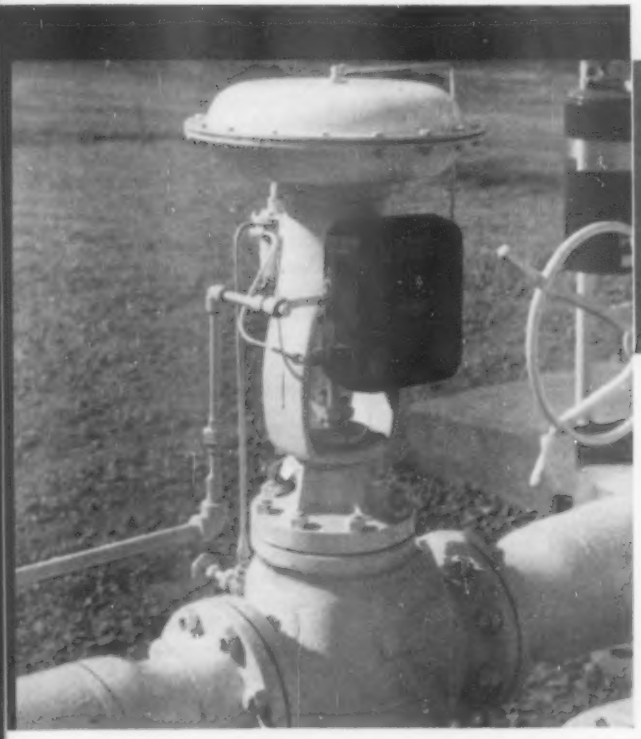

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## Here's what's been learned about

# Dehydrating Natural Gas at the Wellhead

### New dry-desiccant wellhead adsorption unit is automatic and portable

**by A. S. Park* and W. M. Dow†**

EXTENSIVE laboratory research and field testing have resulted in the development of a new, small, short-cycle, dry-desiccant adsorption unit for gas-wellhead applications. A fully automatic, self-contained, and skid-mounted unit may be used to dehydrate the gas stream and to extract additional hydrocarbons. No external source of energy, other than the gas stream to be dehydrated, or external cooling medium is needed.

Some 24 wellhead adsorption units have been placed in operation. Applications range from straight dehydration to maximum hydrocarbon recovery. These units have proved the basic dehydration and hydrocarbon-recovery performance of the adsorption process.

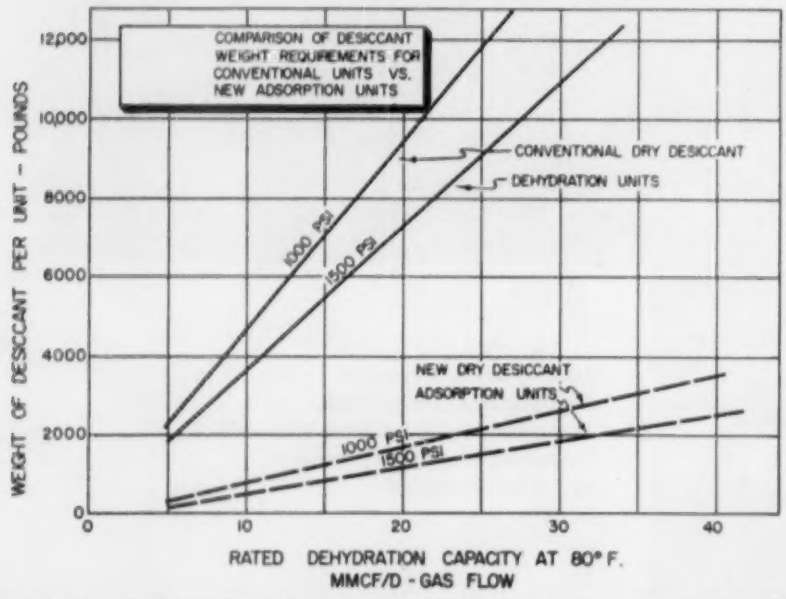
**Size reduction . . .** Laboratory studies indicated that design criteria commonly used in the design of adsorption plants specified many times the quantity of desiccant that was actually necessary for a given capacity. These studies indicated that only a fraction of the amount of desiccant as specified by the accepted criteria could be used to dehydrate gas in a wellhead unit.

To substantiate the results of the laboratory calculations and studies, field tests were made with beds of desiccant in pressure vessels operating under actual field conditions. Results from these tests were encouraging.

From the data obtained from these single-test packs, twin-pack semiautomatic units were designed and put into operation at Carthage field. The instrument house was equipped with a recording dew-point instrument and recorders for all rates and temperatures throughout the test units. Complete records were kept; any questionable data were checked, even to the extent to constantly checking the dew-point recording instrument accuracy by laboratory tests on the gas.

Based on results obtained from the Carthage tests, desiccant pack sizes were calculated for the range of dehydration requirements needed in wellhead units. Fig. 1 illustrates the contrast in weight of desiccant required for a wellhead unit and that used in some conventional dehydration plants. Design for a wellhead unit specifies that the processed gas shall have a water content of less than 7 lb. per million at all times. To be safe, the quantity of desiccant actually required is doubled to allow for decreased efficiency of the desiccant with time.

*Consultant, Houston; and †United Gas Corp., Shreveport. Paper presented at A.P.I. Southern District production meeting, San Antonio, 1956, under the original title, "Development of Dry-Desiccant Wellhead Absorption Units."




**WEIGHT OF DESICCANT required for a wellhead unit as compared with that used in some conventional dehydration plants. Fig. 1.**

**Cycle studies . . .** The number of cycles of adsorption and regeneration is sometimes used as a yardstick of useful desiccant life. This is of extreme importance in the operation of a small well unit, since short time cycles, 2 hours or less, are desirable. To study the effect of rapid cycling on a desiccant, samples of desiccant were taken from beds that were in continuous service.

A sample of desiccant that had been subjected to 3,000 cycles of adsorption and regeneration still had 90 per cent of the capacity of new desiccant. Desiccant used in large conventional dehydration plants ordinarily is expected to last 500 to 1,000 cycles before being renewed. Thus the number of cycles of saturation and regeneration is not the controlling factor in desiccant life.

Having thus determined that a small body of desiccant could perform the adsorbing job required, and that the life of the desiccant would not be shortened by the unusual treatment in the wellhead unit, designs were made for twin desiccant-pack adsorption units.

Reduction in weight of the desiccant vessels not only serves to reduce manufacturing cost, but also reduces the over-all heating and cooling requirements.

**Vessel design . . .** A single vessel is used; part is horizontal, and part is vertical. There are no valves that allow parts of the vessel to be isolated from the others. The vessel contains inlet gas-liquid separator, liquid accumulation chamber with liquid dumping control, two desiccant packs, regeneration gas cooler and condenser, and provision for separating

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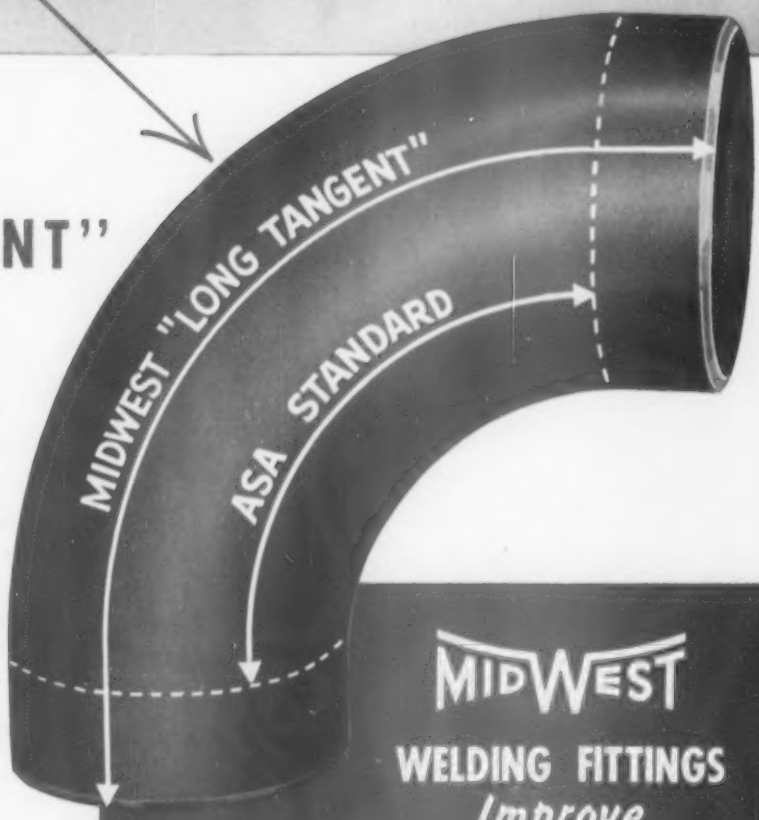


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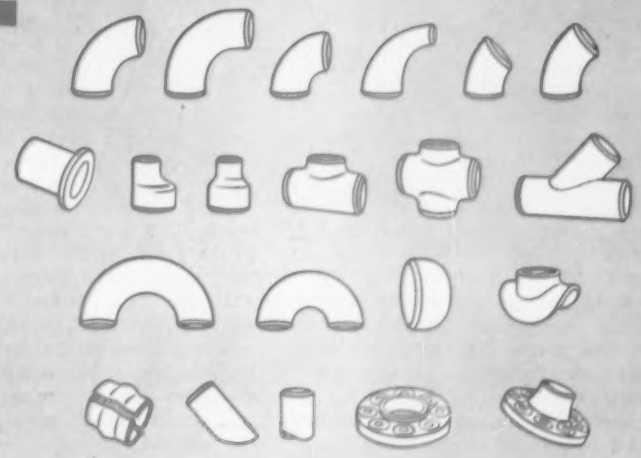

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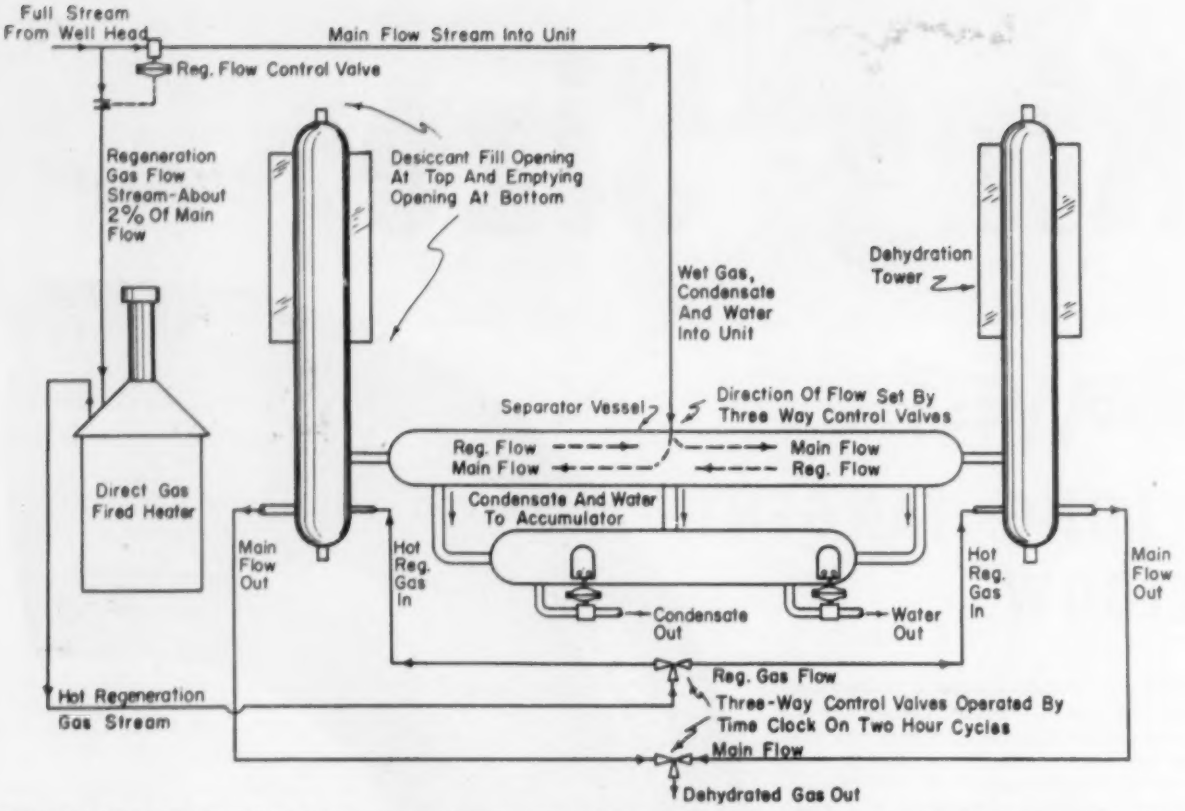
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Reg. Flow Control Valve
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Wet Gas, Condensate And Water Into Unit
Dehydration Tower
Separator Vessel
Direction Of Flow Set By Three Way Control Valves
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Main Flow
Main Flow
Reg. Flow
Direct Gas Fired Heater
Condensate And Water To Accumulator
Main Flow Out
Hot Reg. Gas In
Hot Reg. Gas In
Main Flow Out
Condensate Out
Water Out
Reg. Gas Flow
Hot Regeneration Gas Stream
Three-Way Control Valves Operated By Time Clock On Two Hour Cycles
Main Flow
Dehydrated Gas Out

**SCHEMATIC FLOW DIAGRAM of the arrangement of the parts of the wellhead vessel. Note that this minimizes interconnecting piping and valving. Fig. 2.**

liquid condensed from the regeneration stream and dumping this liquid.

A full-opening, zero leakage three-way valve located at the junction of the outlet lines from the two desiccant packs serves to direct flow through the tower which is adsorbing. A small high-temperature three-way valve serves to switch the flow of hot gas from the heater through the bed that is regenerating.

Fig. 2 is a schematic flow diagram of the arrangement of the parts of the vessel which minimizes interconnecting piping and valving.

**Heat balance . . .** The approach to the heat-balance problem consisted of two parts: first, to reduce the quantity of heat used for regeneration so as to minimize the cooling problem; and second, to find a means of disposing of the heat contained in the hot regeneration stream without heating the gas stream entering the pack being saturated.

Reduction in quantity of heat required resulted from a reduction in the physical size of the pack and vessel, plus more efficient use of the heat used in the regeneration process. Where conventional dry-desiccant units may require 10 per cent of the throughput gas for supplying the regeneration heat, heat requirement has been reduced in the wellhead to the point where less than 2 per cent of the maximum throughput is required for regeneration. This leaves only a fifth of the cooling problem that the conventional unit has.

The use of a double-walled vessel to contain the desiccant bed makes it possible to direct the hot gas flow from the pack into intimate contact with the outer wall of the vessel, which is finned for heat dissipation to atmosphere. Considerable heat is removed at this point. Flow of the partially cooled regeneration stream is directed into the end of the horizontal section of the vessel, and moves toward the center to rejoin the incoming stream of gas.

The heat contained in the hot regeneration gas stream from the bed is stored in a mass of material located in the end of the horizontal section of the vessel, and is not carried by the gas to the center of the vessel to increase the temperature of the incoming stream. Thus, the hot gas stream from the pack being regenerated is cooled to the temperature of the main stream before admixing. The water content is the same, and there is no increase in temperature or water load of the gas going to the saturating pack.

The stored heat has not been removed from the system; it is only stored, and must be removed ultimately. The schematic drawing, Fig. 3, shows that there are twin heat-storage masses in the horizontal-vessel section; and as the cycle switches, flow reverses direction from the central point of entry of wet gas. The hot gas from the pack being regenerated enters the horizontal section at the end and flows toward the center.

As the main flow switches direction in this horizontal section, it goes through the mass that has just had a quantity of heat stored in it, and sweeps the heat out in a very short time. The temperature of the gas going through the adsorbing bed is relatively high for a few minutes; but in the wellhead unit, this mass of hot gas has a negligible effect on the adsorptive capacity during this time.

### Controls

In order to realize the maximum performance from a bed of desiccant, the heating and cooling cycles must be properly controlled, much more accurately than is ordinarily done in a conventional plant using a large mass of desiccant.

It is imperative that the desiccant bed

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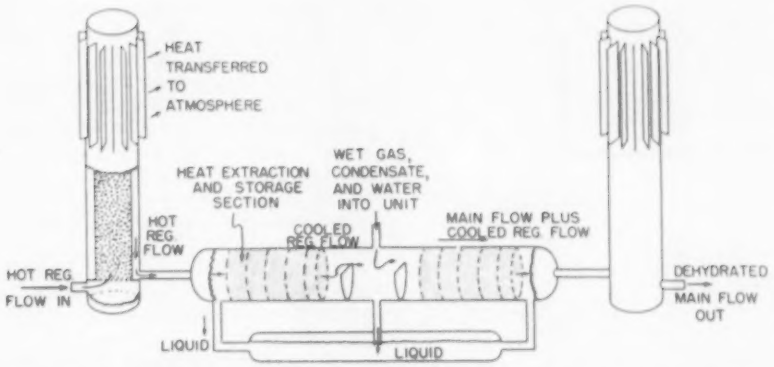



**TWIN HEAT-STORAGE MASSES in the horizontal-vessel section absorb heat from the hot regeneration-gas stream. Fig. 3.**

in a wellhead unit be completely regenerated during each cycle. If insufficient heat is applied to the pack to accomplish this, part of the bed is left in a saturated condition, which reduces the effective size of the desiccant bed for the subsequent saturating cycle. Reduced bed size means reducing adsorbing capacity.

The continued application of heat to the desiccant bed after regeneration is complete may be equally bad for the over-all efficiency of the wellhead unit. Carried to extreme, such excess heat would overload the heat-storage section, heat would spill over into the incoming stream of gas to increase the temperature of the gas going to the pack then adsorbing. This results in a decrease in efficiency.

Several types of controls for the basic heating and cooling cycle have been tested. Most of the units presently in the field are equipped with electric control systems. The electrical power is generated by a commercial thermopile incorporated in the pilot burner of the heater. The thermopile output also serves as a safety cutoff for the heater fuel in the event of a pilot burner outage.

**Time-cycle controller . . .** A time-cycle controller driven by a clock has been used to switch flow and start the heater burner at the beginning of a regeneration cycle. A temperature-sensing element located within the desiccant pack signals the time at which regeneration is complete, and this signal cuts off the fire in the heater. When the pack is cooled, the time clock switches flow and starts a new cycle.

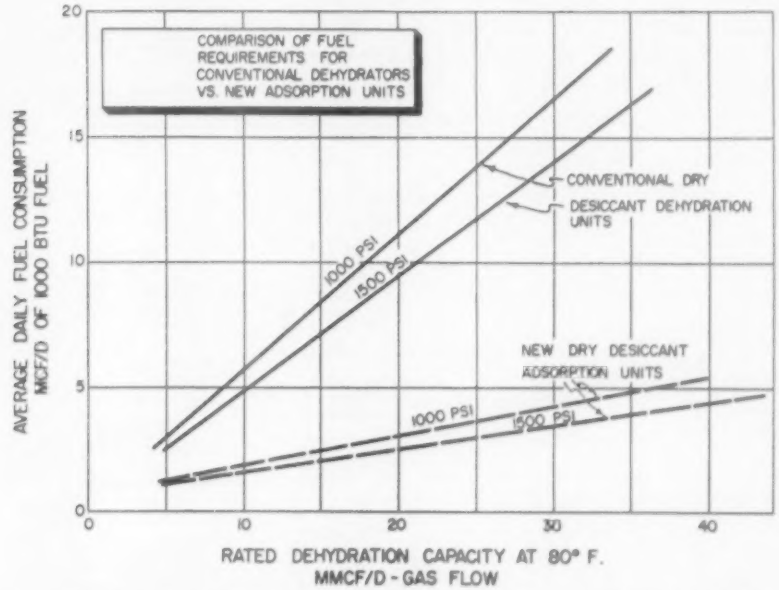
The rate of heat input into a bed during regeneration is a function of rate of regeneration-gas flow and its temperature. Thus, it is important that this rate be held to the required amount in respect to the flow of the main gas stream through the unit. The temperature of the gas from the heater is controlled by a thermostat in the heater outlet line.

**Changing gas flow . . .** A combination rate-sensing and flow-throttling device was developed, with the characteristic of varying the rate of regeneration-gas flow, to meet the requirement of changing main gas flow through the unit. Cost of the controller is not much greater than that of a simple motor valve such as would be used with a standard rate-control instrument.

In some wellhead installations it is desirable to control the temperature of the gas flowing through the unit by means of a controlled pressure drop from flowing wellhead pressure. The efficiency of the wellhead unit is more sensitive to temperature change than to pressure change.

Units have been installed with a motor valve throttling flow into the unit, with the degree of throttling being controlled by the temperature of gas flowing to the unit. The pressure can vary from wellhead to pipeline in the unit, provided it is designed to withstand the maximum wellhead pressure.

Stable control of this throttling valve was ultimately achieved by developing a temperature-sensing device which is clamped on the outside of the pipe carrying gas to the unit. The changes in length of the pipe caused by small temperature changes are sufficient to actuate a controller which, in turn, positions the motor valve.



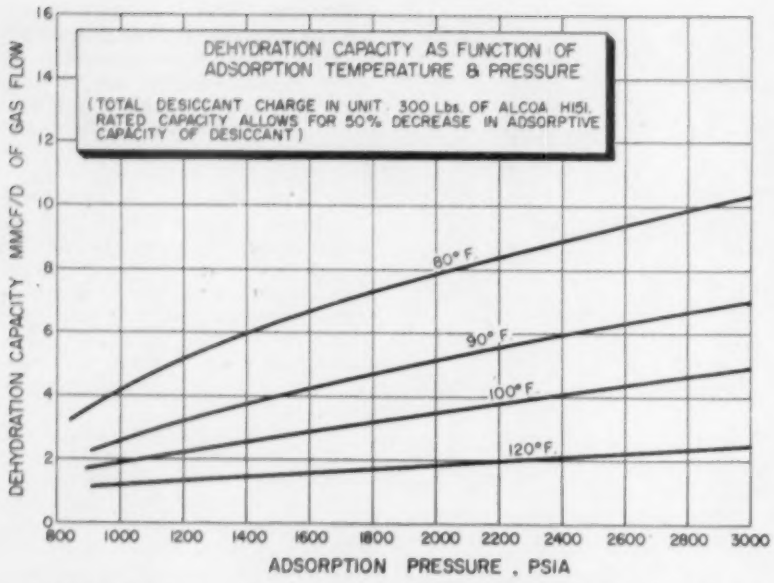

**FUEL REQUIREMENTS for wellhead dehydration units as compared with conventional dehydration units. Fig. 4.**

**Safety devices . . .** Wellhead adsorption units are frequently installed in isolated places, with the rate of flow through the unit being controlled from a point on the line some distance from the well. If for any reason flow through a unit should be stopped, the heater should not be allowed to come on as overheating of the heater tubes could result.

Various safety devices have been tested. Such a device must positively block the flow of fuel to the heater burner when flow through the regeneration system stops.

The most satisfactory and foolproof control system has proved to be a pneumatic device. A temperature-sensing element is installed in a deep well located inside the inlet pipe to the heater. The well and sensing element are of sufficient length to extend well inside the heater firebox.

Under normal flow conditions, the incoming regeneration-gas stream maintains the temperature-sensing element at line temperature. Should flow




**CAPACITY CURVES for dehydration with wellhead unit having towers built from 12-in. 3,000-psi. pipe. Fig. 5.**

through the regeneration system stop and the fire remain on, this section of the inlet pipe to the heater will immediately start to heat. The control is set to block the burner fuel when a relatively slight rise in temperature occurs at this point.

Devices that sense a rise in stack temperature were abandoned as experience showed that by the time sufficient rise in stack temperature had occurred to cause the controller to cut off burner fuel, damage to the heater tubes might already have been done.

**Heater . . .** Design and development of a heater of suitable characteristics for use in the wellhead adsorber required considerable time and effort.

Field-test data taken at Carthage indicated that higher regeneration efficiency could be had by heating the regeneration gas to a temperature somewhat higher than that commonly used in conventional dehydration plants. It was decided to use a regeneration-gas temperature of 600° F.

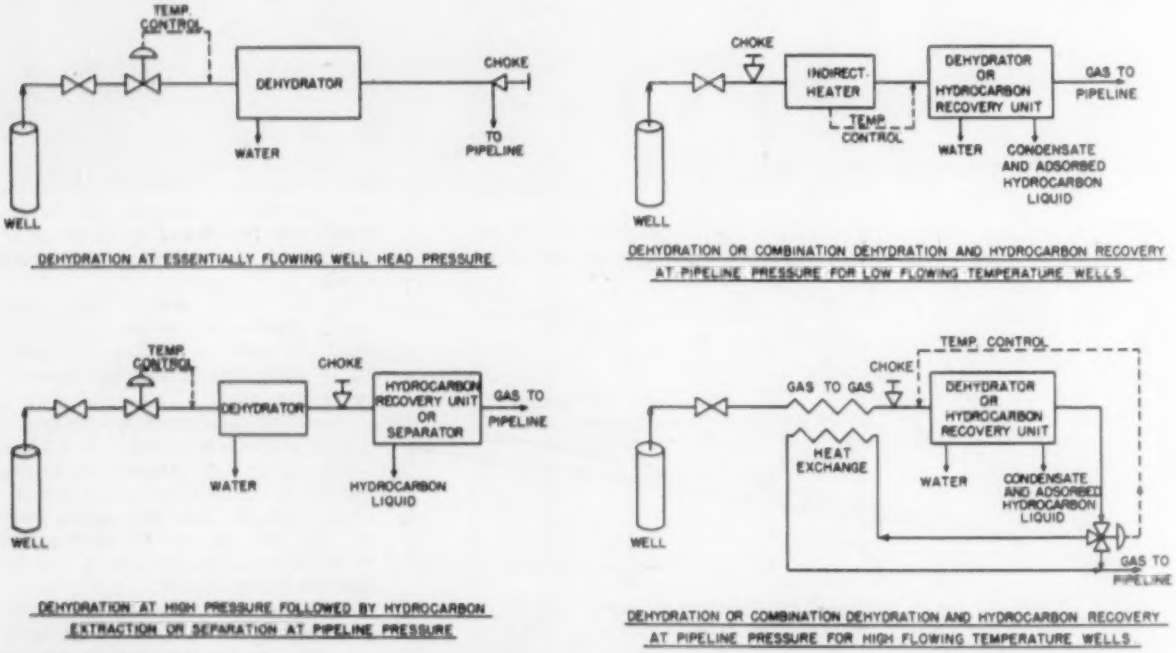
The use of salt-bath or vapor-type heaters was not practical, so a direct-fired heater was developed. Bypassing of the heater during the cooling period was not desired, and thus the heater had to have a low mass to retain heat, both in the fire tube and in the heater housing.

In effect, the heater had to be such that gas at regenerating temperature would flow from the heater soon after starting the fire, and the temperature of the gas from the heater had to drop to essentially line temperature shortly after cutting the fire.

All efforts were made to minimize losses in the heater. Test heaters were built with thermocouple junctions at pertinent locations and studies of combustion efficiency were made from flue-gas analyses taken under all conditions of burner-air supply. The entire combustion chamber is surrounded by an insulated box; the outer wall of the box never becomes too hot to hold a hand against. The burners are designed and constructed especially for these heater requirements. Heaters have been built in capacities ranging from 50,000 to 1,000,000 B.t.u. per hour.

Fig. 4 shows the fuel requirements for the wellhead dehydration units as compared with conventional dehydration units.

**Pressure drop . . .** In one large conventional dehydration plant operating at




**WELLHEAD HOOKUPS may be varied depending on the flowing pressure and temperatures of the individual well. Here are four possible combinations. Fig. 6.**

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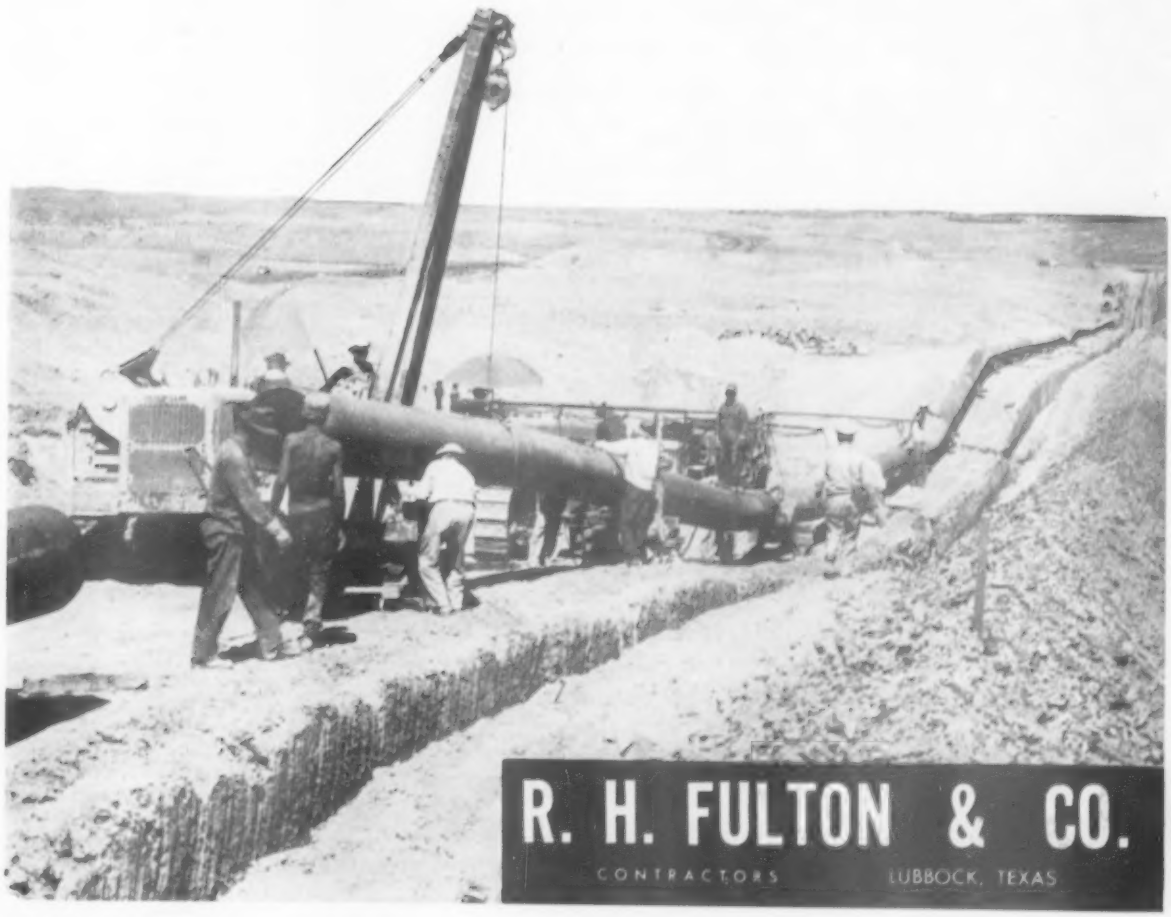

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the rated capacity, pressure drop through the bed was 3 psi.; over-all plant loss of pressure was 18 psi. A similar study of a large wellhead unit showed a 5-psi. drop across the bed, with an over-all pressure drop of 12½ psi. across the unit.

The explanation for the low over-all pressure drop through the wellhead unit is the simplified piping and the use of a single full-opening three-way valve to control flow instead of the multiple valving necessary in conventional plant flow patterns.

Small adsorption units are ordinarily used on individual wells where pressure drop is not critical. It is in the dehydration of gas which is compressed that pressure drop becomes of major importance, and it is in this application that larger volumes of gas may be handled.

### Field Installations

Wellhead adsorption units have been installed and operated under widely varying conditions. Operating pressures have ranged from 50 to 3,500 psi., and temperatures have ranged from 45° to 120° F. Some 24 of these units have been placed in operation to this time, with applications ranging from simple dehydration to maximum hydrocarbon recovery.

A summary is given in Table 1 of the operating conditions and results of some of the field installations. Comparative hydrocarbon-recovery tests were made on a hydrocarbon adsorption unit and a low-temperature separator which were installed in parallel on a high-pressure gas-condensate well in South Louisiana. The piping was arranged so that flow could be switched through either unit.

The well supplying gas to the two units was located at a point about 2 miles away, so a dehydration unit had been installed at the wellhead to prevent freezing of the flow line from the well to the production site. Therefore, a pressure drop could be taken into the adsorption unit without fear of hydrate formation in the inlet piping.

The temperature of the gas to the adsorption unit was 45° F., whereas in the low-temperature separator it was 20° F. By virtue of the lower separation temperature more, about 2 to 3 bbl. per day, of the hydrocarbons in the well stream were condensed in the low-temperature separator than in the separator of the wellhead absorber.

However, the wellhead absorber extracted 7 to 8 bbl. of condensate per day from the gas stream to give a net production increase of the adsorption unit over the low-temperature separator of about 5 bbl. per day. The operating conditions and results of the comparative recovery tests are given in Table 2.

### Application of Units

Simple dehydration of natural gas by the use of a wellhead unit requires no variation in the combination of the basic elements which comprise the complete unit. The quantity of gas to be dehydrated, with its inherent water-vapor load which is fixed by temperature and pressure, determine the size of the equipment. Thus, dehydration equipment may be designed on the basis of gas volume, temperature, and pressure.

For illustration, capacity curves for dehydration with a wellhead adsorption unit containing 300 lb. of desiccant and having towers built from 12-in. 3,000-psi. pipe are shown in Fig. 5.

In general, an adsorption unit designed to recover the maximum of hydrocarbon from a gas stream will have much larger beds of desiccant than will units to dehydrate the same volume of gas.

For maximum hydrocarbon recovery, it is necessary to operate on as rapid a cycle of saturating and regenerating as possible. Rapid cycling requires a high rate of heat input to the desiccant bed to shorten regeneration time. Cooling of the hot regeneration stream requires a corresponding increase in rate of heat dissipation.

In general, it is desirable to operate


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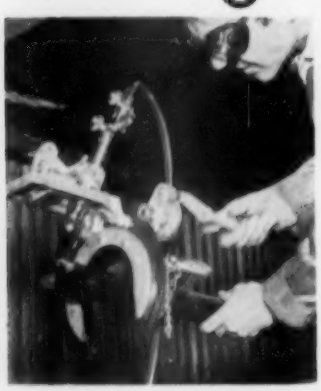

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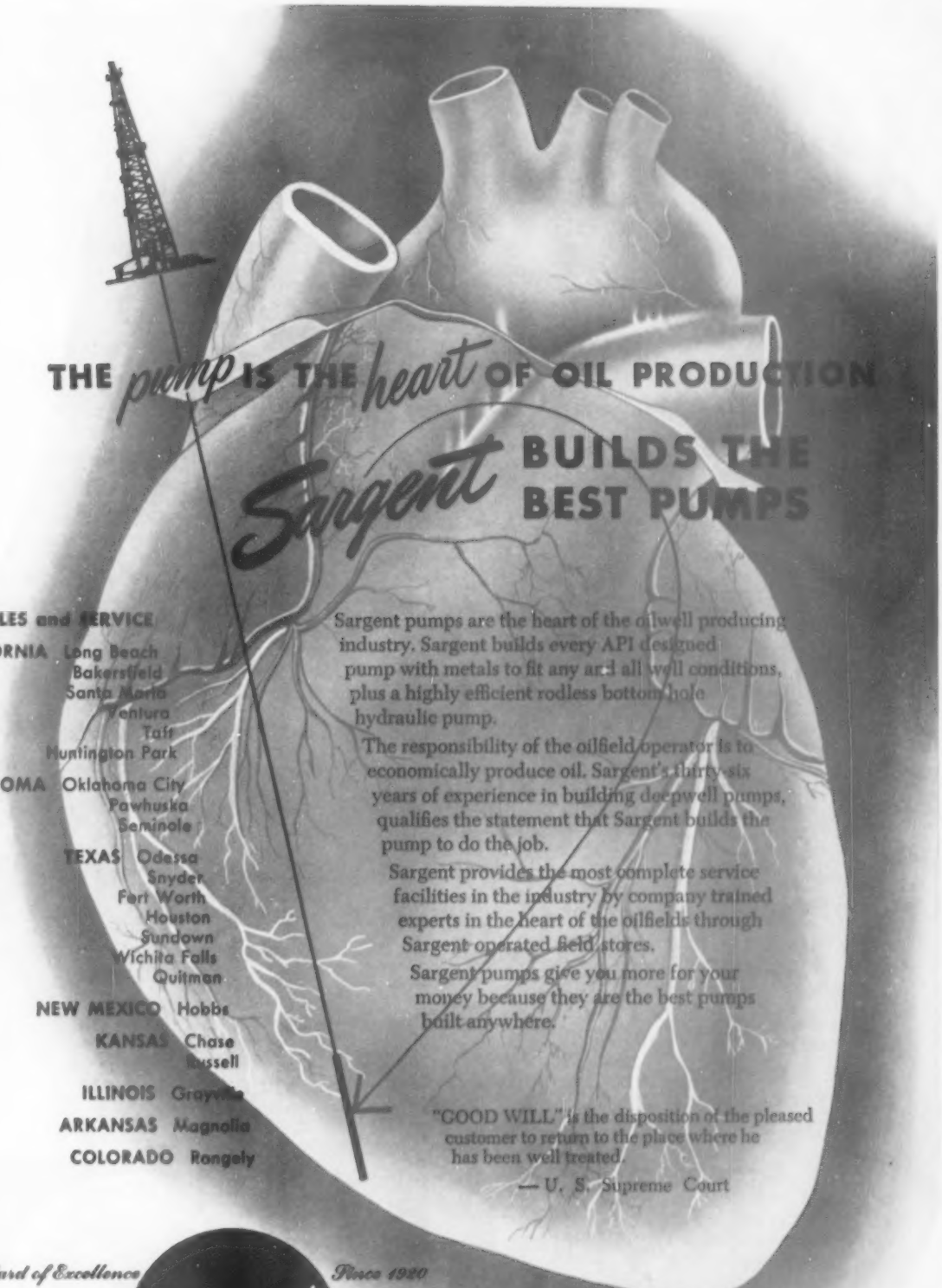

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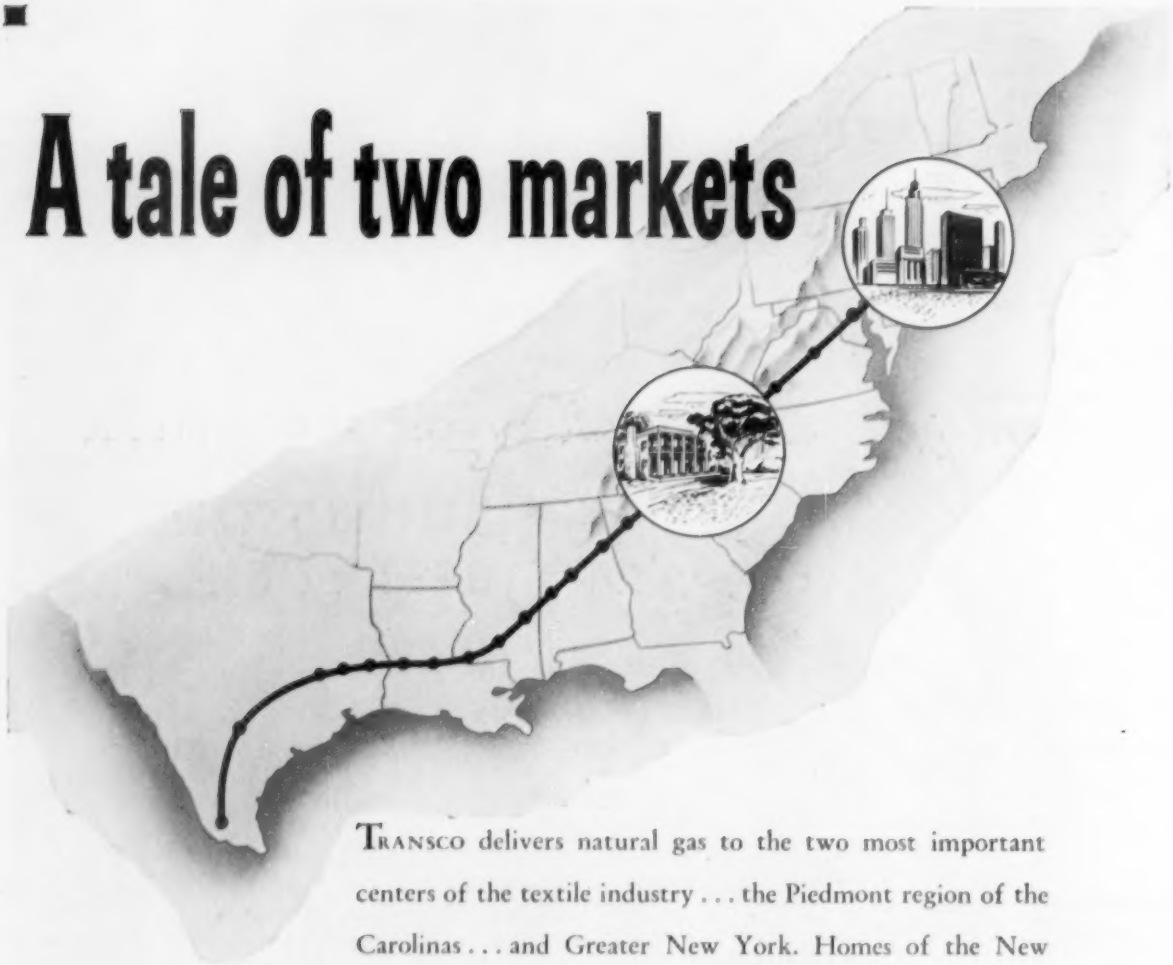

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TABLE 1—SUMMARY OF OPERATING CONDITIONS AND RESULTS OF FIELD INSTALLATIONS

| Size of unit— | Operating conditions: Flow, M.M.c.f.d. | Pressure (psi.) | Temp. (°F.) | Pressure drop: Across bed (psi.) | Across unit (psi.) | General performance |
|---|---|---|---|---|---|---|
| 12-in., 1,500-psi., 400 lb. desiccant | ½ to 1½ | 500 to 700 | 80 | 4 | 25 | Outlet humidity about 1 lb./M.M.c.f. Recovered 2 bbl./M.M.c.f. additional liquid. |
| 12-in., 3,500-psi., 300 lb. desiccant | 4 to 6 | 3,100 | 95 | 10 | 22 | Outlet humidity about 3 to 6 lb./M.M.c.f. |
| 30-in., 1,000-psi., 2,600 lb. desiccant | 5 to 10 | 500 | 90-95 | 4 | 15-22 | Outlet humidity about 2 to 6 lb./M.M.c.f. |
| 12-in., 850-psi., 460 lb. desiccant | 1 | 250 | 85-90 | 5 | 15 | Outlet humidity less than 2 lb./M.M.c.f. 1 to 2 bbl. per day of liquid recovery. |
| 16-in., 1,000-psi., 700 lb. desiccant | 4 | 800 | 105-115 | 4 | 20 | Outlet humidity about 4 to 7 lb./M.M.c.f. |
| 12-in., 1,000-psi., 420 lb. desiccant | 1½ | 800 | 90-95 | 2 | 7 | Outlet humidity about 1 lb./M.M.c.f. |
| 10-in., 850-psi., 320 lb. desiccant | 1½ | 500 | 75-30 | 7 | 11 | Outlet humidity 1 to 2 lb./M.M.c.f. |

TABLE 2—COMPARATIVE TESTS WITH LOW-TEMPERATURE SEPARATOR AND WELLHEAD ADSORPTION UNIT

| | Low-temp. separator: Test No. 1 | Test No. 2 | Wellhead adsorber: Test No. 1 | Test No. 2 |
|---|---|---|---|---|
| Length of test (hours) | 24 | 24 | 24 | 24 |
| Rate of gas flow (M.M.c.f.d.) | 4.3 | 4.2 | 4.4 | 4.3 |
| Operating pressure (psi.) | 950 | 950 | 920 | 920 |
| Operating temperature (°F.) | 20 | 20 | 45 | 45 |
| 24-hour ratio (bbl./M.M.c.f.) | 12.8 | 13.2 | 14.1 | 14.2 |
| Total stock tank liquid (bbl.) | 55.1 | 57.6 | 61.3 | 61.4 |

Additional stock-tank condensate recovered by adsorption in wellhead unit was about 7 to 8 bbl. per day.

Additional stock-tank condensate recovered by wellhead over low-temperature separator was about 5 bbl. per day.

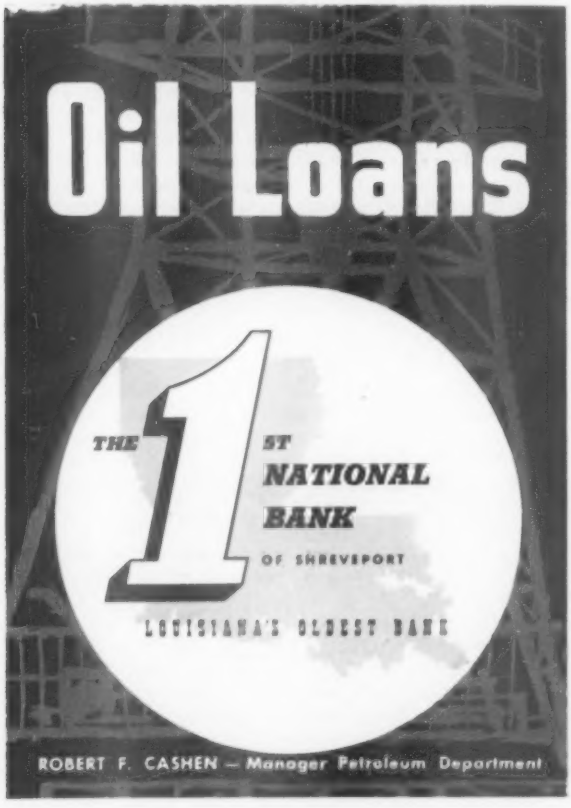
Gallons of pentanes plus per M.c.f. of outlet gas from wellhead unit was 0.080; and of outlet gas from low-temperature separator was 0.125.

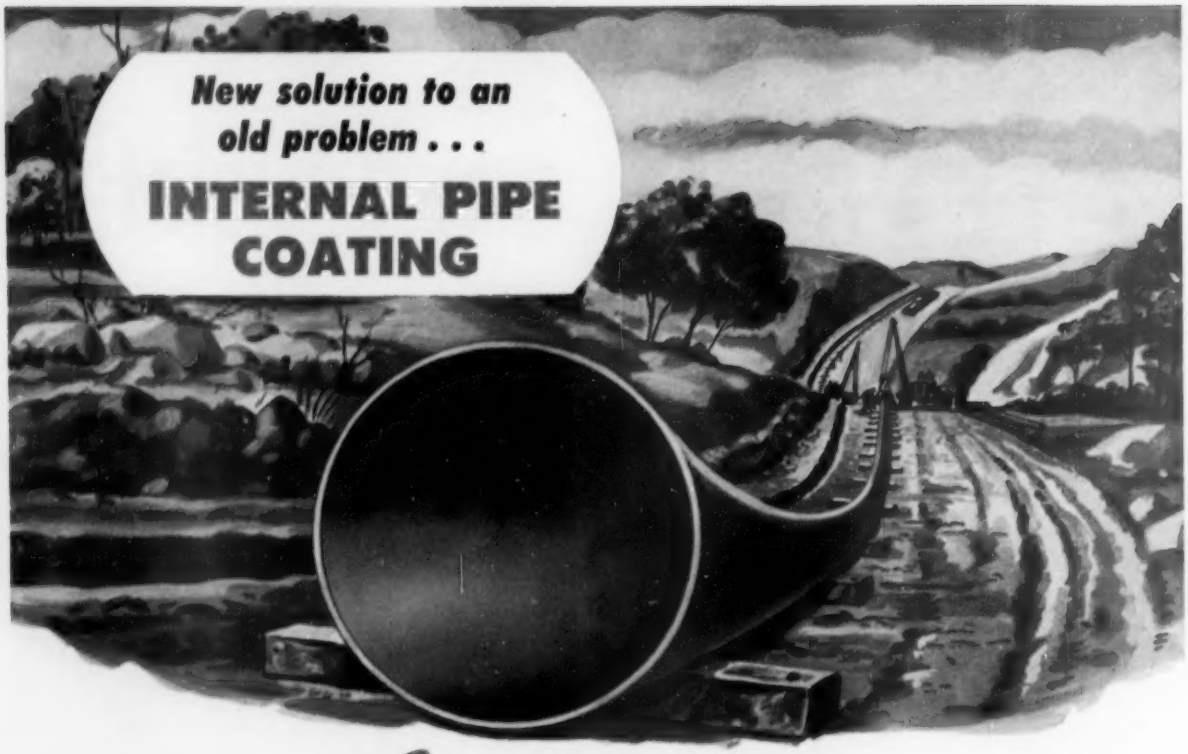
a hydrocarbon-recovery unit at pipeline pressures, 500 to 1,200 psi., and not at higher pressures in order to obtain the maximum amount of natural condensation of hydrocarbon liquid. The additional recovery of liquid hydrocarbons results from the adsorption of hydrocarbon vapors from the separator gas by the dry-desiccant beds.

Depending upon the flowing pressures and temperatures of each individual well, it may be desirable to install a high-pressure dehydrator, a line heater, or a gas-to-gas heat exchanger upstream of the hydrocarbon-recovery unit. In some cases it is possible to throttle directly into the hydrocarbon-recovery unit. Various types of wellhead hookups are shown in Fig. 6.

**Combination unit attractive . . .** At the present stage in the program of applying the wellhead unit to field operations, it appears that the type of installation most attractive to the operator is a combination dehydration and hydrocarbon-recovery unit. This involves the installation of a wellhead unit which is oversized for the dehydration requirement with the additional adsorption capacity of the unit recovering stable stock-tank liquid.

The cost of extra capacity in a unit is small in comparison to the value of additional liquid recovery. Wellhead hydrocarbon adsorption units can recover from 2 to 4 bbl. more of condensate per million cubic feet of gas than can conventional wellhead separators.

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*Producers look to the courts for answers to...*

# HOW TO LIVE UNDER FPC

**Everybody — including the courts — was caught off base by the veto of the Harris-Fulbright bill.**

**So there's a log-jam of 60 or 70 pending cases appealing FPC rulings—some of them 18 months old.**

**Just about everything FPC has done regarding producers since the Phillips decision is under attack, and the legal snarl gets more intricate every week.**

**Final answers will be long in coming. But some court cases due for early decision should throw much light on the problem.**

**Here's a nonlegal rundown of the more important problems of producers and the issues the courts are facing.**

- FPC can't answer many of the questions gas producers have raised since veto of the Harris bill.
- And those answers it has given are challenged on many legal grounds by various producers.
- That's why the whole problem of how to do business under the present law is tied up in the federal courts.

**by Henry D. Ralph**

LOOK to New Orleans for answers on how gas producers can live under regulation of the Federal Power Commission.

During the week of April 16 the United States Circuit Court of Appeals for the Fifth Circuit, sitting in New Orleans, heard oral argument on a group of 30 cases brought by independent producers contesting rulings and decisions of FPC.

These 30 cases—many of them consolidated for argument—involve scores of questions which gas producers all over the country have been asking.

The Circuit Court probably won't answer all of them. And any answers it gives may be appealed to the Supreme Court before they are final. But lawyers can't conceive how the court could dispose of these cases without making some significant guide posts for applying the 1938 Natural Gas Act to independent producers as required by the Supreme Court decision in the Phillips Petroleum Co. case.

Of course, the New Orleans court isn't the only one with gas cases before it. It just happens to have the largest concentration of the most important ones.

A recent count showed more than 70 gas cases pending on federal court dockets throughout the country — all appealing from FPC rulings and decisions. About 60 of these cases involve independent producers in one way or another. And new cases are being taken to the courts every week.

**Legal log jam . . .** The reason for this legal log jam is that practically everybody—including the courts—expected the Harris-Fulbright bill to become law. Its enactment might have wiped most pending cases off the dockets and FPC would have started all over again on a new system of regulation. So the judges put off hearing gas cases, usually with the approval of the attorneys for both FPC and the companies involved.

Now there is a big push to get these cases decided, and the next couple of months should bring forth some very interesting decisions. Whether they answer producers' questions or just create more uncertainty remains to be seen.

Also, FPC got busy on its own docket right after the veto, and is grinding out decisions on cases that had been pending for months. Many of these are inevitably headed for the courts. It's a great day for lawyers. In 1 month after the veto, the Federal Power Commission Bar Association gained 50 new members.

The answers to producers' questions have to come from the courts because of the way FPC undertook to handle the job thrust on it by the Phillips decision of June 7, 1954. Instead of going at the job slowly, a piece at a time, it issued its series of orders Nos. 174, 174-A, and 174-B. These orders were sweeping in nature and general in terms. The commission has declined to issue policy statements or clarifying interpretations. And its own decisions on individual cases have established no discernible pattern.

**Universal ignorance . . .** The Harris bill veto was on February 17, but to date nobody — absolutely nobody — knows what gas producers must do if they want to comply with the law—or what they can do if they want to avoid certain aspects of FPC control. It's no exaggeration to say that there is just as much confusion and uncertainty today as there was when the Phillips decision came down almost 2 years ago.

That's why gas producers are anxiously awaiting the outcome of several score pending cases. Each of these cases involves many issues and much highly technical legal procedure and argument, and it is impossible to forecast whether or not a court will decide a given point squarely and without room for further equivocation.

But to assist nonlegal Journal readers in deciding where to look for possible answers to various questions all producers have raised, this article summarizes the more outstanding issues in a number of the key cases.

## WHO IS COVERED?

The basic question is: Who is covered by the Phillips decision; what is the extent of FPC jurisdiction over producers; what is a sale in interstate commerce; what is left of the exemption for production and gathering?

This point is raised in a series of cases challenging the validity of the

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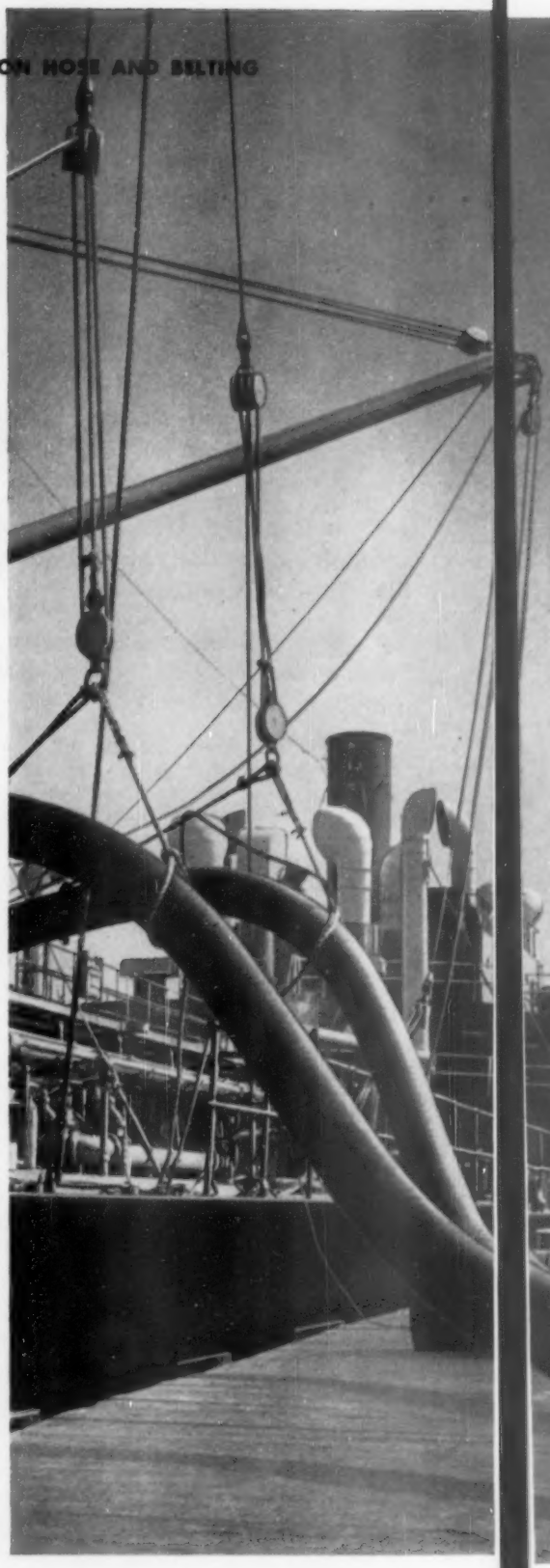

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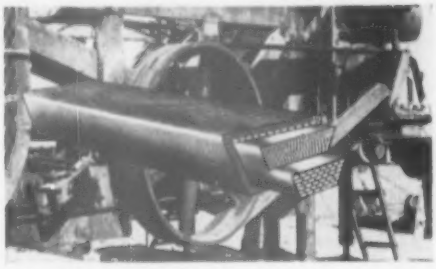

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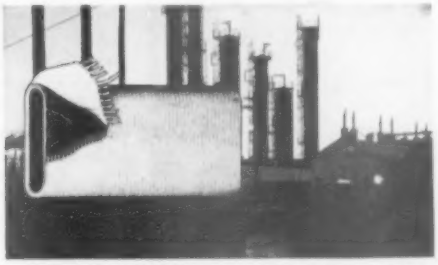

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## THESE MAJOR PROBLEMS face independent producers in dealing with FPC

1. WHO IS COVERED? FPC blanketed all producers in its Order No. 174. Several producers have gone to court with the argument that certain producing and gathering activities are exempt from control. So far the courts have avoided ruling, but other cases are on the way.

2. CASING-HEAD CONTRACTS. A key case in New Orleans challenges FPC's ruling that producers are subject to regulation even though they have no control over the disposition of their casing-head gas.

3. CERTIFICATES: It seems to be settled that a producer must have a certificate to sell gas interstate. But several companies are fighting FPC's action in forcing certificates on them against their will.

4. PRODUCING FACILITIES: FPC is trying to sneak through the back door to get control over physical facilities of producers and avoid a court test on its jurisdiction.

5. RATES IN CERTIFICATES. In one hotly contested case, FPC is trying to fix a producer's initial price as a condition to a certificate to sell in interstate commerce.

6. ABANDONMENT: FPC says a producer can't stop deliveries to a pipeline even though he has an escape clause in his contract. Two pending court cases challenge this.

7. RATE SUSPENSIONS: Can FPC suspend the operation of a price increase called for in a producer's initial contract? FPC says yes, but producers are appealing to the courts.

8. THE MOBILE CASE: Producers say this recent Supreme Court decision prevents FPC from interfering with existing price contracts. FPC denies this, and only the courts will have the final answer.

9. ESCALATIONS: FPC is moving to eliminate favored-nation and various other types of price step-ups, but its legal grounds are hazy.

10. FIELD PRICES: The recent Panhandle decision apparently prevents FPC from giving much consideration to average field prices as a measure of whether a producer's price is reasonable.

11. LACK OF PRECEDENTS: The few cases in which FPC has approved a producer's price increase set no precedents and established no pattern to guide other producers in justifying their prices.

12. JUST AND REASONABLE PRICES: FPC says it has no formula for determining the reasonableness of producers' prices, but its staff seems hell bent to use the utility cost formula. This method faces some bitter court tests—and some surprises.



174 series of orders. Immediately after these orders were issued, several producers went to various courts for injunctions. In every decision so far the courts have avoided any attempt to define or interpret these orders. On various jurisdictional and procedural grounds they have said, in effect, that the complaining producer does not yet have the factual or legal basis for taking FPC into court. The producers are trying to get rehearings on some of these decisions, or to get them reviewed by the Supreme Court.

But in the New Orleans Circuit Court, two producers—Magnolia Petroleum Co. and Ohio Oil Co.—got a "temporary" stay order preventing FPC from applying Order 174 to them. Other producers coming in a few days later weren't so lucky. The court told them to comply with 174 until it could hold a hearing on the Magnolia and Ohio cases—a hearing that wasn't scheduled until 18 months later.

**Not like Phillips . . .** Magnolia and Ohio claim that all kinds of things are wrong with Order 174 series, including the assertion that they are not "natural-gas companies" under the act or under the Phillips decision.

In the Phillips case the facts admittedly were that Phillips, in addition to producing, also bought gas from other producers, transported it, processed it, and sold the residue to interstate pipelines. The Supreme Court said that Phillips' sales were made "in" interstate commerce "after" production and gathering had been completed. Magnolia and Ohio say that while their gas may be produced "for" interstate commerce, their wellhead sales are made in the course of production and before gathering is completed, and therefore their wellhead sales are not sales "in" interstate commerce.

They argue that FPC cannot make a blanket order classifying all producers as natural-gas companies, but that it must investigate each one separately to determine whether its business is similar to Phillips' or whether it is exempt as production and gathering.

If the New Orleans court should uphold Magnolia and Ohio in this interpretation, every producer in the Fifth Circuit (Texas, Louisiana, and Mississippi) could get the same right to ignore FPC until FPC specifically determines, after investigation and hearing, that its sales are the same as those covered in the Phillips decision.

At least three other Circuit Courts have refused to find the 174 orders invalid or inapplicable to the producers who appealed—in each instance on

**"The Deep South case . . . presents for the first time the question whether a sale of natural gas made before the completion of production and gathering is exempt from the Natural Gas Act."**

technical grounds and without considering the merits of the complaints. If the New Orleans Circuit Court makes a different finding, this conflict would immediately go to the Supreme Court for final review. In the meantime, attempts are being made to get reconsideration of the other decisions which refused to inquire into the merits of Order 174 at this stage.

### CASING-HEAD CONTRACTS

In addition to these long-pending 174 cases, many court appeals from recent FPC actions involve the question of what producers are subject to regulation. In fact, practically every case in the courts raises some aspect of this problem.

Foremost is the Deep South-Humble-Shell case, involving several varieties of casing-head-gas contracts. Most of the gas here is sold at the wellhead to either gatherers and processors rather than to a transmission line. The intermediate buyer or processor later sells the residue gas in interstate commerce, but the producers have no control over these sales.

This important case is awaiting decision in the New Orleans Circuit Court. The FPC, in its decision in the case last September, recognized the importance by saying that it presents for the first time "the question whether a sale of natural gas made before the completion of production and gathering is exempt from the Natural Gas Act."

**Everything covered . . .** How the FPC answered this question is told in a few quotes from the majority opinion:

"There is an uninterrupted flow of natural gas from the wells across state lines . . . Hence, we find that the natural gas is sold in interstate commerce. . . If only a portion of the gas crosses the state line as an integral part of a commingled mass, it is immaterial. . . The fact that the producers had no control over the gas after it was sold to the gatherers or processors is not controlling. . . Nor is it necessary to intend to sell in interstate commerce. Reasonable anticipation that the gas flows in interstate commerce is sufficient. . . . When the gas was sold by the producers it commenced its flow in interstate commerce. . . . The fact that the gas was sold to an intermediary such as a gatherer or gasoline plant which, in turn, resold the gas in interstate commerce, does not affect our finding."

Commissioner Digby wrote a 25-page dissent from this 12-page decision, arguing that such a blanket ruling goes beyond the scope of the Phillips decision and beyond the language of the Natural Gas Act. He said that direct wellhead sales into interstate pipelines are under FPC control, but various types of intermediary sales and processing agreements are not.

The whole industry is looking to the New Orleans court for an early answer to this question.

### CERTIFICATES

Every producer who sells gas to an interstate pipeline must have a certificate of public convenience and necessity. There seems to be little doubt that the law requires this, although there is considerable doubt as to the wisdom of such a provision.

But there is much argument over the way in which FPC applied the law in

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its 174 orders and in subsequent cases. The question is before the courts in several cases, including all those challenging the validity of 174.

Commissioner Digby, in his dissents from the 174 series and from other orders, says that the act should be applied so as to give producers the option of withdrawing from interstate sales. He points out that a necessary requirement for a certificate is proof that the applicant is both able and willing to perform the service.

**Willing or not . . .** The 174 orders make it mandatory that producers apply for certificates whether they are willing or not. Many producers have filed under protest, stating that they are not willing to perform the service under the conditions laid down by FPC. They hope in this way to provide a legal "out" for contesting the requirement in court.

The only conceivable reason for requiring a producer to have a certificate is to give FPC more complete control than it might otherwise have. By applying for and accepting a certificate a producer, in effect, implies that he is doing business under sufferance of FPC and is subject to its dictates.

**"The action of a majority of this commission issuing a certificate for 'whatever facilities' is improper for it represents an assertion of power denied to us by the Congress." (Commissioner Digby, dissenting.)**

By its insistence on certificates, FPC apparently is trying to clinch its power over producing facilities, over initial prices, and over abandonment of service.

### PRODUCING FACILITIES

There is a strong body of opinion that the law does not give FPC any jurisdiction over the physical facilities used in producing and gathering gas, whatever its control may be over sales and prices. The legal arguments supporting this view are many, and are raised in several appeals before various courts.

FPC has dodged this issue. In every certificate it has issued a producer to sell gas interstate it has inserted some such phrase as this: ". . . together with the construction and operation of any facilities used for the sale or transportation of natural gas in interstate commerce, subject to the jurisdiction of the commission."

By this device FPC declines to say whether or not any producing facilities are under it but keeps a string on the facilities in case the issue is ever determined in its favor.

**Improper assertion . . .** Commissioner Digby dissented from this procedure, saying: "A certificate of public convenience and necessity is neither required nor properly issued for construction and operation of facilities of a producer and gatherer. The action of a majority of this commission issuing a certificate for 'whatever facilities' is improper for it represents an assertion of power denied to us by the Congress."

In some of the court appeals, producers are pointing out that FPC never in the past required interstate pipelines to obtain certificates for facilities used solely in production and gathering. In some instances FPC is requiring producers to get certificates to deliver gas to uncertificated gathering facilities of interstate lines.

This matter—along with a great many other issues—is involved in the so-called La Gloria Area case involving

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Once a producer gets a certificate covering a particular sales contract, he can drill additional wells and install other gathering facilities necessary to fulfill the contract without an additional certificate for such additions. At least that is the way the law is being applied, although FPC has issued no formal decisions on the question.

### RATES IN CERTIFICATES

FPC claims the right to regulate prices in connection with issuing a certificate to a producer. The key case on this issue involves Cities Service Gas Co. and Signal Oil & Gas Co.

Here FPC gave Signal a certificate to sell residue gas from its Oklahoma natural-gasoline plant to Cities Service's interstate line on condition that it charge only 10 cents per M.c.f. instead of the 12 cents provided in the contract.

**FPC dodged . . .** The majority of FPC didn't say 10 cents is the proper rate. In fact, it said that the question of a just and reasonable rate could be brought up at some later time. It simply said that the applicants had not proved that that 12 cents was reasonable, so it conditioned the certificate on a 10-cent rate to "maintain the status quo" until further proceedings are brought.

Commissioners Kuykendall and Digby dissented on the ground that FPC has no authority to put price conditions—or perhaps any conditions—on a producer's certificate. Admitting that this has been done (without being tested in the courts) in the case of pipelines, these commissioners pointed out that the situations are far different and that it is wrong to use certificates as an instrument for regulating producers' prices.

### ABANDONMENT

At least two key cases are pending that involve the right of a producer to abandon service to an interstate pipeline.

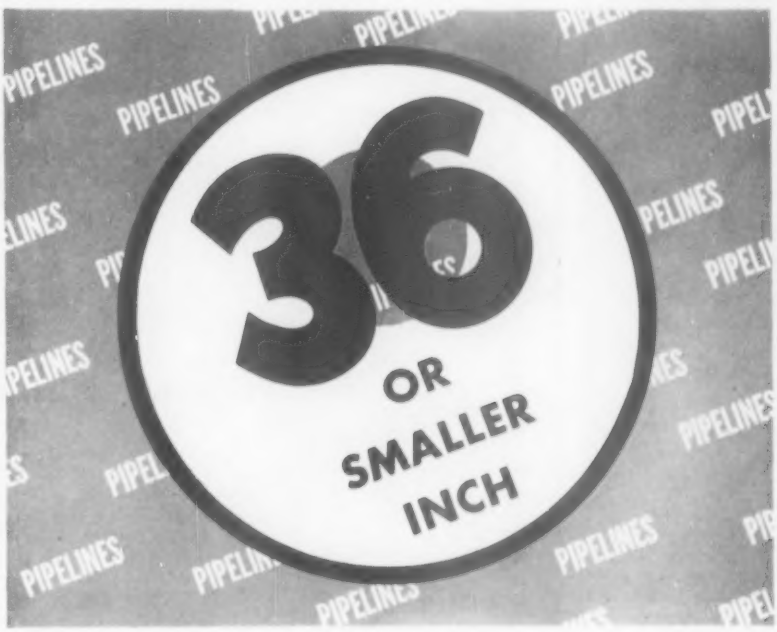
These producers had "escape clauses" in their contracts under which they reserved the right to terminate deliveries if any federal agency attempted to exercise control over them. When Order 174 was issued these producers elected to withdraw from interstate business rather than apply for certificates to continue In each case the pipeline complained, and FPC required the producers to accept a certificate binding them to continue the service.

These cases are being appealed to different courts, so it is possible that there will be two different and irreconcilable opinions before the question gets to the Supreme Court. The companies involved are J. M. Huber Corp. in the Third Circuit and Argo Oil Corp., et al., in the Fifth Circuit.

**Recycle problem . . .** The Argo case is a complicated one and involves a great number of legal issues. It is the case of the 16 producers in the La Gloria field area of Texas, selling to Texas Illinois Pipeline Co. This is a unit operation in a recycle field. Some of the gas is recycled to the producing formation under authority of the Texas Railroad Commission, and some was sold to the pipeline. The producers decided they would recycle all of it and—later—got approval of the Railroad Commission.

The pipeline and its customers claimed that this was just an excuse to void the contract. FPC agreed and ordered producers to keep on delivering gas.

The appeal in this case involves not only the right to stop service but many other things as well, including the need for producer certificates, certification of production and gathering facilities,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**"Producers to a man contend that . . . FPC cannot suspend a price stepup that was called for in a contract in effect prior to June 17, 1954, the date of the Phillips decision."**

authority of state conservation bodies, and the position of parties in a unitized operating agreement.

**RATE SUSPENSIONS**

The question of greatest importance to producers at the moment is the right of FPC to set aside the price schedules called for in contracts in effect before the Phillips decision.

This is the so-called suspension power. Under Section 4 of the Natural Gas Act, FPC has authority to suspend the application of a proposed rate change pending an investigation into its reasonableness. Under Section 5 of the act FPC may investigate any rate at any time and establish a new rate if it finds the old one not just and reasonable.

The act does not permit FPC to suspend the "initial" rate schedule filed by a new pipeline coming under regulation for the first time. The Phillips decision and Order 174 brought producers under regulation for the first time. They were ordered to file their sales contracts as rate schedules.

The question is: Are these price filings by producers "initial rate schedules" and therefore beyond the power of suspension by FPC?

**What's a "new" price . . .** Except in a very few cases, FPC has not attempted to suspend the first rate filed by a producer. But when an increased price comes along under the provisions of an escalation clause, FPC says that is a new filing and can be suspended. It has suspended something like 200 proposed price increases by producers, and is hopelessly behind in trying to adjudicate these cases. Many of the increases are being collected under bond, subject to refund if and when FPC finds them unreasonable.

Producers to a man contend that the "initial filing" is the entire contract, escalations and all. Therefore, they argue, FPC cannot suspend a price stepup that was called for in a contract in effect prior to June 7, 1954, the date of the Phillips decision.

The issue is before several courts in a variety of appeals. What producers feel is complete endorsement of their position came from the Supreme Court in February in the Mobile case, and this decision is being called to the attention of every Appellate Court.

Producers say the Mobile case unequivocally prohibits FPC from suspending the provisions of a sales contract. FPC hasn't said what it thinks, officially, but some of its people say the case doesn't go as far as producers claim.

**THE MOBILE CASE**

The Mobile case was a bombshell. Mobile Gas Service Co. had a long-term contract to buy gas from United Gas Pipe Line Co. for resale to a cement plant for industrial use. Later United notified Mobile that it was raising the price. FPC let the higher rate go into effect because the law gives it no power to suspend sales for resale for industrial purposes.

The Supreme Court held that the Natural Gas Act does not permit an interstate pipeline to change a contracted rate by unilateral action. In other words, it upheld the sanctity of a contract.

If the Supreme Court had confined its remarks to the simple question of whether a unilateral change could be filed, the case might have had only lim-

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ited interest. But the decision goes on to say that the function of the commission is not to fix rates, but instead is merely to review rates established in the contracts of natural-gas companies.

**Big hope here . . .** Because of this language, many lawyers are contending that the Mobile decision means that FPC may not use Section 4 (its suspension powers) to set aside a price agreed upon by the parties in an initial contract.

Under this interpretation — which FPC hasn't yet accepted—if the commission thinks that a contracted price is unreasonable it must proceed under Section 5, that is, it must make an investigation on its own motion and bear the burden of proving that the contract is not just and reasonable.

Producers hopped on the Mobile decision with glee. They contend that this means that escalation clauses in old contracts may not be suspended by FPC, that FPC must let the entire contract stand as written unless and until it conducts an investigation and produces evidence that a specific provision

**"What is a reasonable price for natural gas in the field? . . . FPC has no answer . . . Meanwhile the staff, egged on by distributors, continues its drive to establish costs as the primary, if not the only, basis for setting producers' prices."**

in a specific contract is not just and reasonable.

An opposite view is held by some attorneys. They say that the Mobile decision doesn't necessarily apply to producers, doesn't necessarily apply to sales other than industrial sales, and doesn't necessarily mean that an escalation clause is a nonsuspendable part of the producer's initial rate filings.

The only point of agreement is that it will take a great deal more litigation to determine the effect of the Mobile case on producers' prices.

**ESCALATIONS**

To date every important case involving an increase in producers' prices has concerned an escalation in an existing contract, and some significant court decisions on this point should be forthcoming within a few months.

But regardless of the outcome of those cases there remains the treatment of new contracts involving various kinds of step-ups in prices.

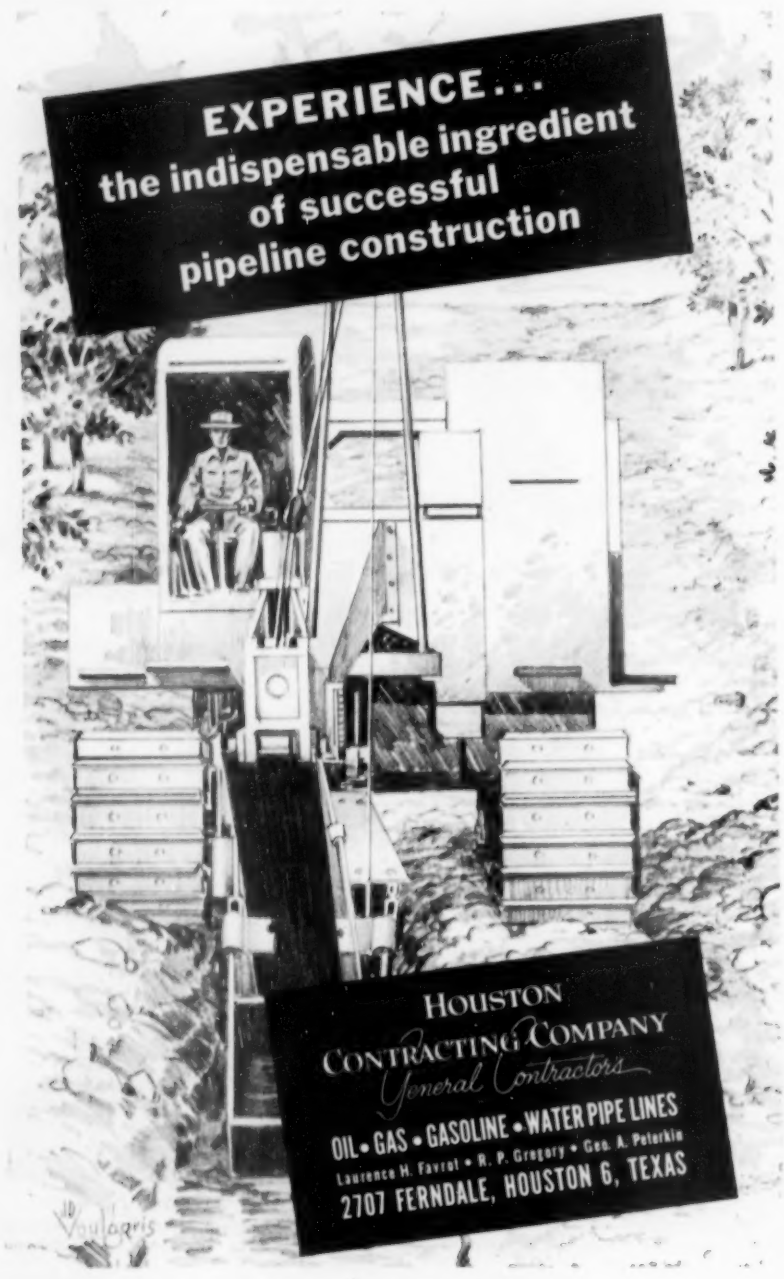
The Harris-Fulbright bill would have outlawed certain types of escalations, and FPC appears to be trying to put this part of the bill into effect by administrative action. It has given notice that it intends to promulgate a rule under which, after July 1, it will not accept for filing any sales contract containing favored-nation clauses or other forms of escalating prices other than periodic increases spelled out in cents and with specified dates.

Favored-nation and other escalations which left future prices uncertain are objectionable to politicians, economists, and utility experts. The legal basis for refusing to accept them under the present law is still to be tested, but apparently rests on the theory that they are not legally rates or contracts because the consideration at any future date is not specified and, in some types, may depend on actions by persons not parties to the contract.

**JUST AND REASONABLE RATES**

The big question remaining after all matters of jurisdiction, certificates, suspensions, and the rest are disposed of, is how to apply to producers' prices the 1938 act's requirement that rates be "just and reasonable."

Even if many producers are exempt-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ed from regulation, even if FPC can't suspend old rates or can't consider rates in a certificate application, sooner or later it must pass on at least some sales to interstate pipelines under Section 5 of the act.

What is a reasonble price for natural gas in the field? How can producers—or anyone else—go about trying to prove that a certain price is reasonable or unreasonable?

FPC has no answer. Many of the eastern gas-distributing companies and the utility commissions of eastern states insist that field prices can be set the same way any utility rate is determined, that is, by fixing a rate base calculated on the cost or prudent investment in the facilities used and then allowing the producer to earn enough return on this to keep him in business, whether this be 6 per cent or 12 per cent or whatever. This is the "utility cost" approach.

**Conflicting views . . .** Producers unanimously say this can't be done and won't work. They make the basic distinction between the cost of facilities for rendering a service—which is what is controlled in utility regulation—and the speculative business venture of producing a commodity. A pipeline or other utility is constantly writing off the cost of its investment in facilities by its depreciation fund. A gas producer is selling off a piece of his irreplaceable property every year, so that utility cost approach has no application.

A majority of the FPC commissioners profess to agree with producers on this point. Not so a majority of the FPC staff.

While the commissioners make public statements saying that some new method must be found for passing on producers' prices, the staff is busily engaged in gathering producers' costs. It has teams of accountants out visiting many big gas producers, spending weeks and months going over the books to determine costs. A good many more such field investigations of producing costs are scheduled for this summer.

**Insistance on costs . . .** In every producer rate case before FPC, the staff insists that the producer justify his rate on the basis of costs. Most producers have refused to give any cost data at all, and in these cases the FPC staff counsel usually moves to dismiss the case and refuse the price increase on the ground that the applicant has not shown it to be just and reasonable.

Few if any of the court appeals involve this question directly and solely, but several are on the way. One such involves Sun Oil Co. Sun failed to justify its price increase (under an escalation contract) on the basis of costs, so the staff moved that the case be dismissed. Instead, FPC gave Sun more time to submit costs. What Sun did was to argue that the utility cost formula is not applicable but instead submitted some "long-haired" economic testimony to show that its prices were reasonable on other grounds. This line of talk rolled off the FPC staff like water off a duck's back. The staff insists on cost data, and most producers aren't about to produce any without a court test.

**FIELD PRICES**

The staff has one leg to stand on in its position. This is the decision of the Circuit Court of Appeals for the District of Columbia in the Panhandle Eastern Pipe Line case. This is the famous case in which FPC, in April 1954, tried to adopt average field prices as the basis for fixing the price of gas produced by a pipeline for its own transmission. The city of Detroit, acting in the name of Panhandle's customers, took the case to court and got it reversed.

Here again there is doubt as to what the decision means. The court didn't say field prices can't be used. It didn't

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say that only the cost basis must be used. It just said that in this case FPC hadn't demonstrated that the particular application of the field-price method to Panhandle had resulted in "just and reasonable" rates for the protection of customers. It sent the case back and told FPC to try again.

**Old tradition . . .** But this decision demonstrates how the courts, and others, adhere to the traditions of utility thinking in approaching the problem of wellhead gas prices. The court said that it is proper to fix prices high enough to give producers an incentive to increase supplies — but not more than enough.

It said that unless and until some better method is developed, FPC should consider costs along with other factors in order to have "an anchor, as it were" and a "point of departure."

This Panhandle decision gives the FPC staff and the other strict regulationists a firm toehold for insisting on looking into producers' costs. FPC is seeking a Supreme Court review of the decision, but so long as it stands FPC must follow it.

### NO PRECEDENTS

Since the Panhandle decision, FPC has written opinions in two cases permitting independent producers to raise their prices, and it is interesting to see how the commission has hedged and dodged the issue. These are the cases of Davidor & Davidor and Wunderlich Development Co. Both were contract escalations stepping up from 5.2 cents to 10 cents per M.c.f. on specified dates. The volume of gas and the amount of money involved were quite small in each case.

Both these applicants gave FPC some cost data, albeit rather sketchy and inconclusive. Over the objections of FPC staff, both introduced evidence to show that the field prices in the areas were 10 cents or more, that the gas had a commodity value of at least 10 cents, and that the escalations agreed to by the pipeline purchasers were for the purpose of developing new business.

**A way out? . . .** What the commission did in both these cases was to discuss costs, field prices, and commodity values in vague and general terms and then conclude that the increased prices were not unreasonable. Presumably this went through the motions of satisfying the requirement of the Panhandle decision that some weight must be given to costs. But FPC gave no formula for weighting costs or any other method, and it kept repeating that its conclusions applied to these particular cases only and did not set any precedents.

The only conclusion to be drawn from the Wunderlich and Davidor cases is that small independent producers may be able to justify moderate price increases on small volumes of gas if they present some cost data along with other evidence.

### THE COST FORMULA

But nobody expects a big producer to get by this easily in a price-increase case involving millions of dollars. Such cases are always fought vigorously by counsel for distributing companies and state utility commissions.

Most big producers at present are determined not to recognize that costs play any part in determining their rates. But some of them—particularly those who are facing Section 5 investigations by the commission—are taking a look at their cost pictures in order to defend against the cost studies which are certain to be put on by the FPC staff and which probably will be admitted in evidence. These producers feel that if costs are presented to the commission by the staff, industry must tell its story,

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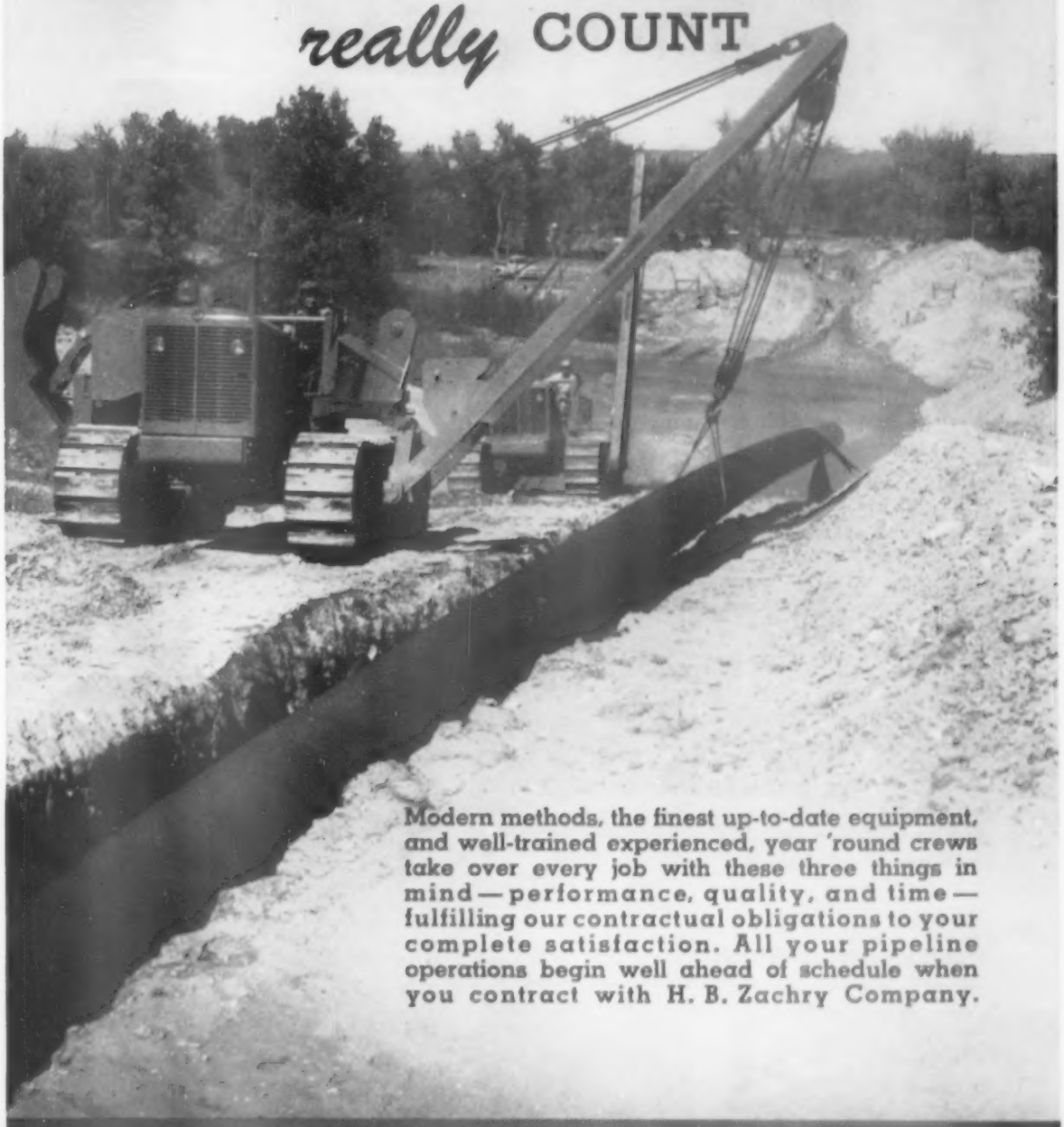

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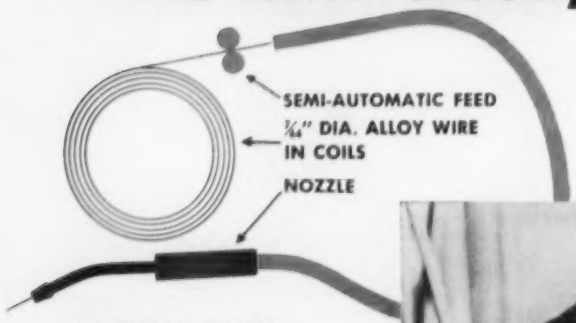


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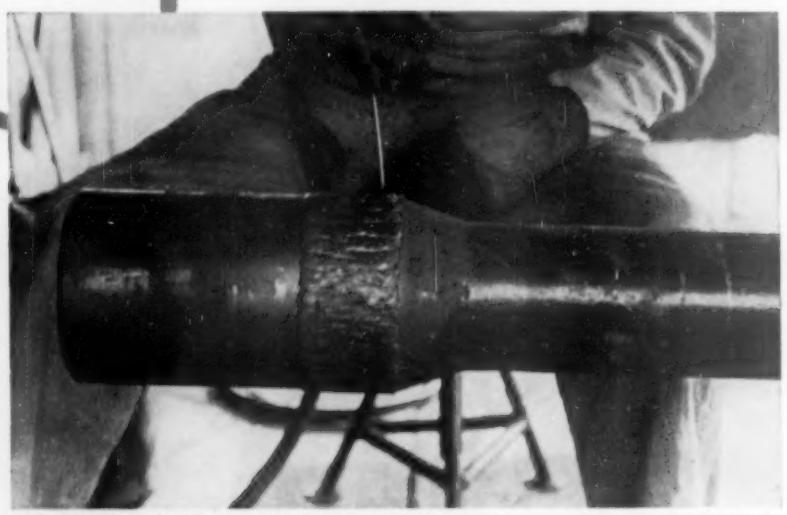

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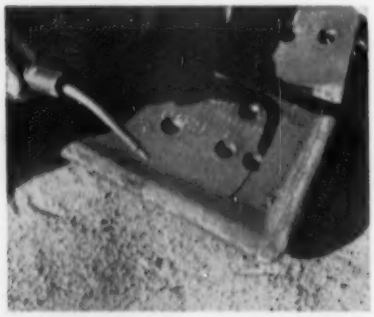

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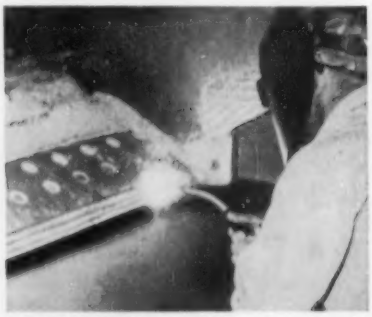

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too, so that the commission does not get a distorted view.

**The big surprise . . .** The cost data prepared by the companies are expected to surprise the advocates of utility-type cost regulation. The companies which are studying their costs are soon finding that, if gas is assigned anywhere near a fair share of the joint costs of producing oil and gas, gas is substantially underpriced and may even be selling at a loss.

Some of the FPC commissioners have already made public statements to the effect that some gas producers are selling below cost.

Even in preparing this data, producers by no means intend to retract from their repeated statements that regulation by FPC—in any form—is harmful to the consumer and the public as a whole. Producers believe that, even if costs are favorable, the mere fact of the uncertainty and perhaps changing character of FPC's regulatory policies, the opportunity for "juggling" allocations, and the desire of some advocates of regulation to require producer's oil operations to bear an undue portion of total costs will make producers reluctant to develop their gas properties and sell their gas in interstate commerce.

But producers are beginning to believe that the cost data demanded by the advocates of utility-type regulation will prove nothing—except that gas is underpriced in relation to cost.

Meanwhile the staff, egged on by distributors, continues its drive to establish costs as the primary, if not the only, basis for setting producers' prices. But as more and more cases reach the hearing stage and particularly go to court review, producers believe that position will become more and more untenable.

**One for the books . . .** For example, one case is coming up for FPC hearing within a couple of weeks that is calculated to knock the cost theory for a loop. A producer, long since dead, set up some gas-producing properties as a trust fund for his grandchildren, then unborn. The properties currently sell about $1,500,000 of gas a year to an interstate pipeline. The trustee, a New York bank, has filed for a price increase.

How much does it cost the grandchildren to produce this gas? Their investment is not one cent, for the properties were a gift. Application of the cost formula here will produce a result so obviously ridiculous, observers hope, that even the diehard regulationists will have to concede that some other method will have to be found for determining "just and reasonable" prices for gas producers.

## AND SO TO COURT

Under the present state of the law and the court decisions, FPC couldn't, if it tried, tell independent producers how to justify a price increase or even defend present prices when they are challenged.

On many other producer problems, such as who needs a certificate and what transactions are exempt as producing and gathering, FPC could eliminate much confusion by changing its rules and methods. But it has chosen to take the course of trying to bring everything under its control at once and force producers to go to court to get modifications.

That's why there are so many FPC cases in the federal courts, and why these cases cover scores of separate issues.

And that's why producers are looking to the group of cases already argued before the Fifth Circuit Court of Appeals in New Orleans, and to scattered cases in other federal courts throughout the country, for early answers to the questions that FPC can't or won't give them as to how to comply with the Natural Gas Act of 1938.

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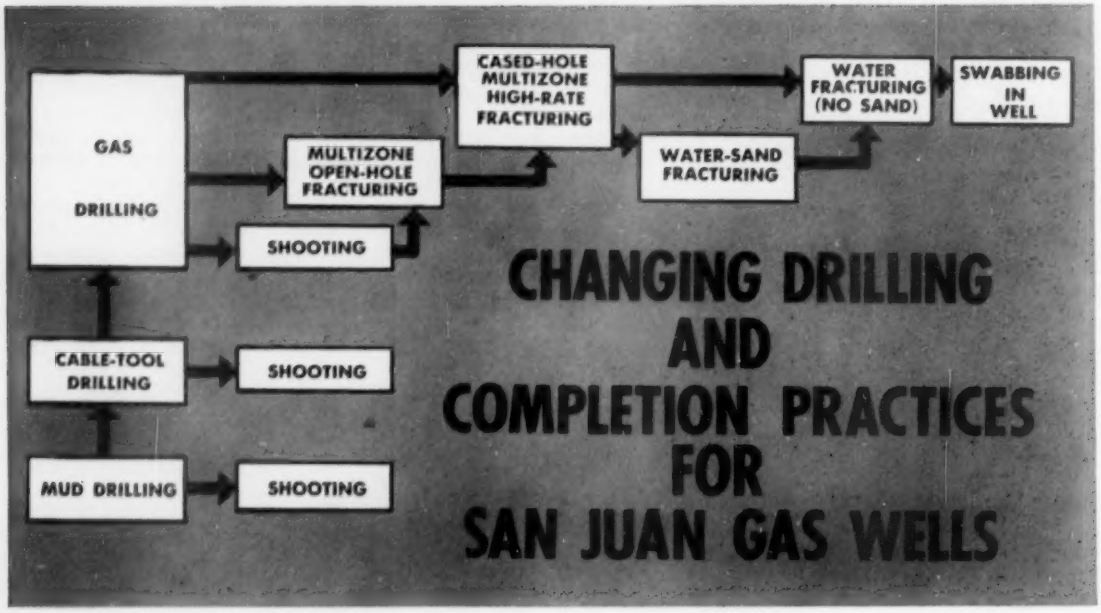


# Drilling Practices Change Fast in San Juan

## High-volume, high-rate fracturing is now an accepted standard

**by W. R. Johnston**

NEW completion techniques such as water fracturing are part of the fast-changing operating picture of the basin which has thrived on gas drilling. Practices here have importance to the whole Rocky Mountain area.

Drilling and completion practices in the San Juan basin have changed radically during the past year. A great number have had a very short life in the basin, and indications are that completion practices will continue to change.

Open-hole shooting with nitroglycerin died with the advent of fracturing. Open-hole completion remained for some time, and still remains in the majority of Pictured Cliffs wells, but has been replaced entirely in Mesaverde by the cased completion. The open-hole bridge plug, which was successful in separating sections for fracturing, departed with the initiation of perforated completions.

The high-volume, high-rate fracture treatment introduced by Pacific Pipeline is now an accepted standard. Fracturing oil was a big business in the basin, but disappeared overnight when the first water-sand fracture was performed last summer. Pacific has now dropped the use of sand with the water, and there is a definite indication that the sand business is well on its way out of the San Juan basin. The latest innovation has been the use of a retrievable wire-line bridge plug instead of the drillable plugs which have caused some difficulty and expense in our completions.

Author is with Pacific Northwest Pipeline Corp., Albuquerque, N. M. Paper presented at 1956 spring meeting of the Rocky Mountain District of the A.P.I. Division of Production, under the original title, "Drilling and Completion Practices, San Juan Basin, 1956."

### Rigs

The drilling rigs used in the San Juan basin are essentially the same that have been used in the past, other than that numerous contractors have improved their equipment, which in my opinion has been greatly responsible for the reduction in accidents by fire that has occurred in the past 2 years. The average rig is 400 to 600 hp. with a thribble derrick, 9 to 11-ft. substructure, a dual, hydraulically operated blowout preventer, with some standby power in the event it is necessary to close the preventer with the engines out of operation. A stripper head is necessary, preferably with a drilling cross for the 7-in. gas-discharge line. Vaporproof lights are becoming standard.

The average Mesaverde well is 6,000 ft. deep, and it takes around 15 days to set production casing and an additional 5 to 6 days to complete. Recently one of the contractors working for our company set 5½-in. casing in 11 days at 5,700 ft. This was the time from spud to rig release, and includes all time necessary to set and cement surface, intermediate string, and production string. The surface and intermediate strings were set with mud and the production hole was drilled with gas, and casing set in dry hole.

Pictured Cliffs rigs are essentially the same as Mesaverde rigs as far as auxiliary equipment goes, but are smaller throughout and generally use a double derrick. From a contractor's standpoint, the best rig for work in the basin is a rig that is small enough to move readily for Pictured Cliffs work, and yet large enough to drill 6,000 ft.

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*Harold Vance, Vice President and Manager, Oil and Gas Department*

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It should be able to set 6,000 ft. of 5½-in. casing in a dry hole, which necessitates good braking on the draw works.

### Casing Program

Because of the present shortage of many sizes of casing, the program now being used in the basin varies by necessity. The preferred program for Mesaverde wells is 10¾-in., 7⅝-in., 5½-in., or 9⅝-in., 7-in., 5-in., both utilizing 2-in. tubing. The 5-in. o.d. production-casing offers an advantage of approximately $3,500 per well, but has been limited in usage because of the shortage of this size casing. Some operators are running 5½-in. casing, with the collars turned down, in 6¼-in. hole.

For Pictured Cliffs wells, only surface and production casing is needed, with the normal program being 8⅝-in. surface and 5½-in. production string with 1-in. or larger tubing. Most Pictured Cliffs wells are presently completed in open hole, but it is thought that the preferred completion would be cased, which will offer the advantages of selective fracturing, which has been so successful in Mesaverde completions. Pacific's Pictured Cliffs wells will probably be drilled with 7-in. surface casing, 4½-in. production casing set through the sand, and 1¼-in. tubing.

### Drilling Practices

The drilling practices in the basin, other than the gas-drilled portion of the hole, are very similar to other Rocky Mountain and West Texas areas. General practice is to set 100 to 200 ft. of surface casing, and 3,000 to 3,500 ft. of intermediate casing, which requires from 6 to 12 days' rig time. High bit weights are used and some operators are using oversize drill collars for at least part of their drill-collar string.

After the intermediate casing is set, the plug and any cement in the casing are drilled with water, then the hole is blown dry and the remainder of the hole is drilled with gas as a circulating medium. Air can be used successfully for drilling this portion of the hole, but is not satisfactory for completion work, because there is the ever-present possibility of a down-the-hole fire. One hole was lost this year when an attempt was made to use air to complete; and it is recommended that, if it is necessary to complete with anything other than gas or fluid, a noncombustible gas, such as exhaust gas, be used for completion.

**Setting oil string . . .** The production casing is set in the dry hole, and is cemented with only 50 bbl. of water ahead of the cement slurry. Cementing results have generally been very good. This has been proved by the fact that very seldom does communication occur during selective fracturing of zones. There has been some difficulty with plug failure, because of the pressure across the plug caused by a relatively low fluid column outside the casing, with the casing full of water inside. When a plug ruptures or float collar fails, the cement slurry invariably is pushed up the hole and can be lost in the porous zones above the pay zone. It now appears that the use of a wooden plug with a rubber plug offers a solution to the problem.

**. . . Drilling problems** in the basin are not serious, but as in all areas, are ever-present. Boulders and gravel beds have given considerable trouble in drilling surface holes. In many areas, gas and water flows are encountered in the Fruitland zone during drilling of intermediate hole. This necessitates the use of mud weights as high as 12 to 13 lb. per gal. when the gas is encountered.

After the intermediate string is set, the most serious drilling problem is water entry, either from a poor cement job on the intermediate casing, or water from the formations penetrated below the intermediate string. A number of occasions of water entering the hole have been caused by damage to the intermediate casing as a result of the use of drill pipe inside the dry casing. Inasmuch as it is necessary to use stripper heads for gas drilling, and because the common type of casing protector will not give any service life due to the erosion of the cuttings during drilling with gas, it is not possible to run casing protectors on the drill pipe.

**Dry-casing failure . . .** Recently on one well, four casing failures occurred at the identical spot in the casing, each resulting in last-engaged-thread failure. The failures were obviously fatigue failures caused by some type of vibration from the drill pipe. These failures occurred approximately 180 ft. down, and were inside the surface casing. On one occasion the intermediate string parted after only 10 hours of rotation with the drill pipe. All failures were corrected by backing off the casing and replacing the bad joint with a new one. It is entirely possible that the sleeve-type rubber stabilizers will serve as protectors for gas-drilling operations. We are now using several of the sleeve-type stabilizers to determine their suitability for this purpose.

In some areas, the Mesaverde formation is highly abrasive and causes considerable trouble with undergage hole. Practically every contractor has learned that an undergage bit will drill as well as a sharp bit when using gas. He therefore makes it a practice to penetrate the Mesaverde zone with a new bit and is very cautious while drilling the 700 ft. of Mesaverde section.

Drilling in a dry hole calls for closer supervision than drilling with mud, as anything that is dropped in the hole can mean a junked, and therefore sidetracked hole. If a string of drill collars or casing is dropped in a dry hole, there is generally no use fishing for them. Invariably the top of the fish will be found several hundred feet lower than would be indicated by the measured length.

### Completion Practices

Most oil people in the Rocky Mountains are entirely familiar with the completion history in the San Juan basin.[1 2 3 4] The gas drilling used in the basin, which was developed by El Paso Natural Gas Co. several years ago, combined with open-hole shooting, made the San Juan basin gas wells commercial ventures.

**Water not damaging . . .** Fracturing replaced shooting, but open-hole completions in the Mesaverde remained because it was believed that water and cement would damage the pay zone. It is now known and has been proved that this is not true; and in my opinion, it is very likely that mud will not injure the pay zone either. The open-hole completions were fractured as they were drilled; i.e., the upper section was drilled and fractured, and then the lower sections drilled and fractured, using drillable retainers set in open hole. This type of completion eliminated the use of large-volume fracture treatments, because it was necessary to fracture down the tubing or drill pipe, and because the open-hole retainer would fail at high injection rates.

**. . . The first improvement** in completion practices was the use of casing set through all but the bottom section and then completion of the lower section of the pay zone in open hole. It was quite obvious that if the upper sections could be completed in this manner, the same method could be applied to the bottom section, so consequently the full cased completion was adopted. The cased completion brought about the use of the three-string drilling program and gas drilling of the bottom 2,500 ft. of the hole.

**. . . Fracturing** has had a rapid and varying growth in the San Juan basin. Diesel oil and sand was considerably more successful than shooting, but was generally used at low injection rates, with volumes not exceeding 20,000 gal. per job. Last year, volumes and injection rates were increased to the point where now the average treatment is 50,000 gal. at an injection rate of from 40 to 80 bbl. per minute. This necessitates from 3,000 to 4,000 hp. The cased completion made it possible to fracture wells in this manner, as all zones can be fractured down the casing.

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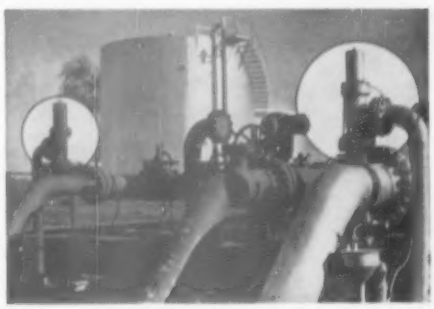

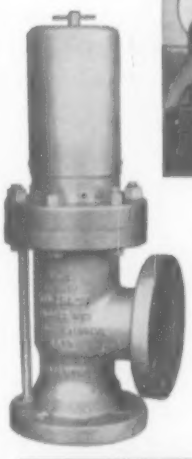

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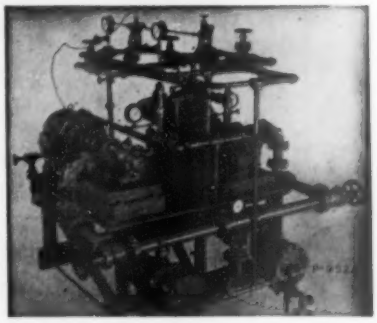

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for fracturing, and this expense was undoubtedly the reason for the initial use of water as a sand-carrying agent in fracture jobs. The water-sand fracture has been very successful in the basin, and has cut down the hazards of completion considerably. One operator fractured a single zone recently with 100,000 gal. of water and 95,000 lb. of sand. They reported the results were excellent, and contemplate more of these exceedingly high-volume treatments.

**No sand . . .** With the problem of high cost of the diesel oil solved, the next item readily discernible in well costs was the cost of sand, which amounted to around $2,000 per zone treated. In addition, the use of sand caused considerable trouble in drilling bridge plugs, and on several occasions caused fishing jobs and sticking of the drill pipe.

Our company performed the first straight water fracture, i.e., without sand, 3 or 4 months ago; and several months ago discontinued the use of sand entirely for Mesaverde wells, as our results with water alone appear to be comparable to results with water and sand. The elimination of sand opened up several possibilities of further streamlining completion practices.

The retrievable bridge plug had not been used in the basin, primarily because of the danger of sticking a plug with sand. With that danger out of the way, the use of wire-line bridge plugs was initiated. With the wire-line plug there is no necessity of using a rotary rig for completion, so it is now our practice to use a cable-tool line or a swabbing line for completion. Following is a review of the latest completion practice for Mesaverde wells in the basin.

**New Mesaverde completion . . .** The 5 or 5½-in. casing is set with a rotary rig, and the rig is released after a check with a wire line to see that there is no cement or plug to drill in the casing. The cable-tool rig or pulling unit completes the well, in combination with the equipment of the various service companies.

Logs are run and the bottom zone is perforated by the logging company, generally with two shots per foot, either bullet or jet. This zone is fractured down the casing with 40,000 to 50,000 gal. of water, at a rate of from 40 to 70 bbl. per minute.

After the first zone is completed, the zone immediately above is perforated, the cable-tool line is run to bottom to flag the line as a reference point, and the wire-line bridge plug is set between the two zones. Then the second and


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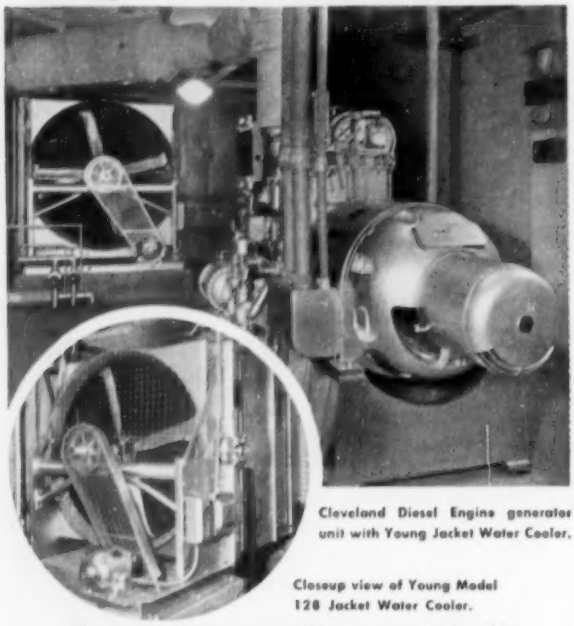

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Closeup view of Young Model 128 Jacket Water Cooler.

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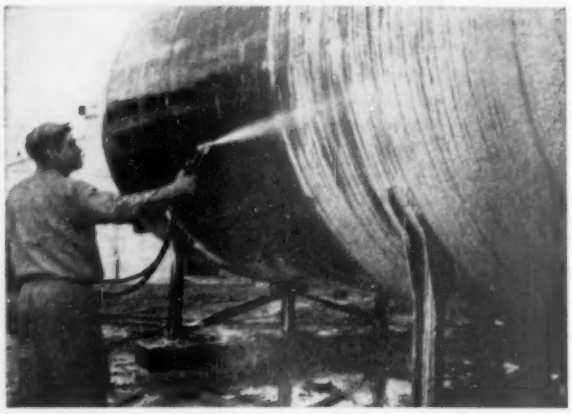
# How to strip a storage tank



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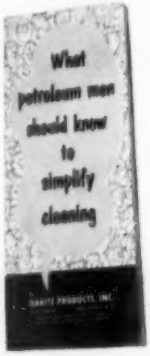


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succeeding sections are completed in a similar manner.

After all zones have been fractured, the tubing is run and the well is swabbed in for the final completion. This swabbing of a well in the basin for completion is entirely new, to my knowledge, and looks like an excellent improvement in our completion practice, because the present method of jetting a hole dry and hanging the tubing with the well blowing is exceedingly dangerous. Most Mesaverde wells are completely dead after fracturing, and it is necessary to remove the water load before they will come in. On a recent completion, a well was swabbed in in 26 hours, which is comparable time to jetting a well and blowing the water out. In my opinion, the use of swabbing for completion should be considered by all operators in the basin.

It is difficult to prognosticate the changes in drilling and completion practices in the basin, but there is no doubt they will change and continue to improve. New ideas, such as wire-line completions and sandless fractures, are reducing well costs which, in turn, allow an operator to spend more money to improve stimulation techniques. There is a great deal of interest among all the operators in the basin, and they all are anxious to cooperate and exchange ideas with one another. The methods that are being tried and have either failed or succeeded in the basin are very important to the whole Rocky Mountain area, because many of these methods will be used to develop the gas reserves which are known and will be discovered in the entire Rocky Mountain and Northwest area.

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## BOOK

SYMPOSIUM ON ROCKY MOUNTAIN OIL AND GAS LAW. Published by Montana Law Review, School of Law, Montana State University, Missoula, Mont. 120 pp., paper back, $1.50.

This symposium covers papers presented at the Rocky Mountain Oil and Gas Law Institute meeting held at Billings last May. Subjects covered are: Reservoir Mechanics; Origin, Accumulation, and Findings of Oil and Gas; Elements of Reservoir Engineering; Nature of the Landowner's Interest in Oil and Gas; Elemental Principles of the Modern Oil and Gas Lease; Assignments by the Landowner and the Lessee; Oil and Gas Interests in a Decedent's Estate; Conservation in Montana; Abstracts and Oil Titles.


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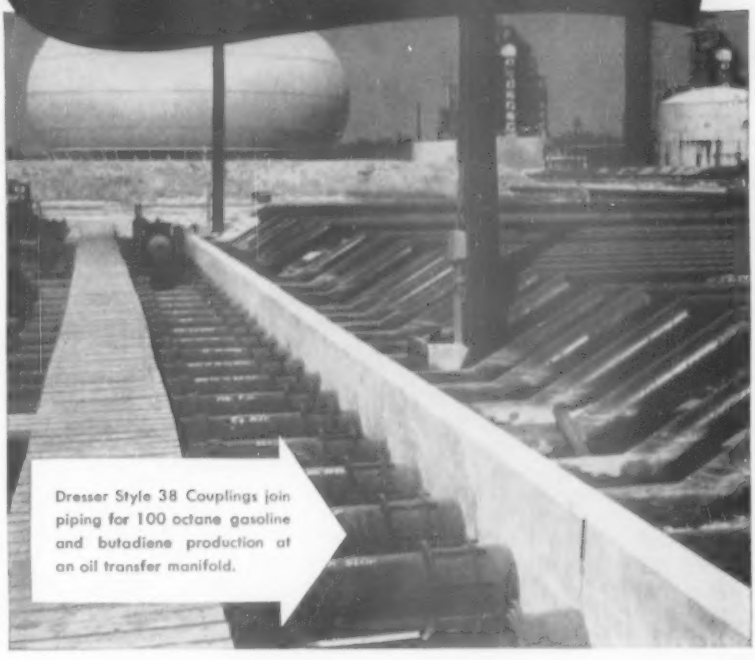

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# Two-Stage Fluid Catalytic Cracking

### *. . . a new technique now used on commercial scale*

**by J. D. Heldman, F. Kunreuther, J. A. Marshall, and C. A. Rehbein**

NEW techniques have been developed in fluid catalytic cracking to provide higher gasoline and lower coke yields and greater flexibility than conventional operation.

The first commercial unit employing these new techniques recently came on stream at Shell Oil Co.'s new refinery at Anacortes, Wash.

Virgin feed stock is first contacted with cracking catalyst in a riser reactor, i.e., a pipe in which fluidized catalyst and vaporized oil feed flow concurrently upward. Total contact time in this stage is short, on the order of seconds. High temperatures are employed to reduce undesirable coke laydown on catalyst without destruction of gasoline by secondary cracking.

All or part of the unconverted or partially converted gas-oil product from the first stage is then cracked further in a fluid bed reactor. By varying conditions in the two cracking zones, wide operating flexibility is obtained for shifting from maximum gasoline to maximum intermediates production.

The underlying principles developed by Shell can also be applied in arrangements other than those used at Anacortes. For example, a single-stage riser reactor unit can be advantageously used to reduce coke make in cases where high conversion is not required. The techniques can be adapted to existing fluid units in some cases as, for example, by adding a riser reactor first stage and other auxiliaries.

**Why two-stage operation . . .** When any mixture of feeds (or even a single feed), having a wide boiling range and a variety of molecular types, is cracked, a compromise severity is required at which the least refractory components are cracked too severely and yield large amounts of gas and coke while other, more refractory components undergo only low conversion. Both overcracking and undercracking prevent realization of optimum potential gasoline yields.

Authors are with Shell Oil Co., at New York, Houston, Wood River, Ill., and Anacortes, Wash, respectively. Paper presented at A.P.I. refining meeting, Montreal, May 14-17, 1956, under the original title, "Commercial Two-Stage Fluid Catalytic Cracking—A New Technique."

Even with feed-stock segregation, the boiling range and molecular type spread of a typical catalytic cracking feed stock are so wide that the operating severity required to achieve a given over-all conversion inevitably results in some destruction of the gasoline initially produced from the least refractory components.

This shortcoming is intensified by the wide distribution of vapor residence times which is found in the fluid beds of conventional catalytic cracking units,[1 2 3 4] and which would lead to overcracking - undercracking losses even with a feed of uniform composition and narrow boiling range.

#### Experimental

The major portion of the experimental work was carried out by the Houston Manufacturing Research Laboratory of Shell Oil Co.

Two pilot - scale catalytic cracking units were employed in the development of the cracking techniques and conditions used in the two-stage process. The first-stage unit, consisting of an upflow riser reactor, a stripper, a regenerator, and product fractionation columns, is capable of continuous operation at throughputs up to 8 bbl. of feed per day.

Second-stage cracking of gas oil from the first stage was accomplished in two dense bed pilot plants. One of these, which has been described in a previous publication,[5] operates semicontinuously at feed rates up to about 1 gal. per hour. The other dense-bed unit consisted of a modification of the dispersed - phase cracking pilot plant in which the stripper vessel was used as a dense-bed reactor. The ranges of cracking conditions investigated in most of the work were as follows:

| | First stage | Second stage |
|---|---|---|
| Temperature, °F. | 875 to 1,050 | 900 to 1,000 |
| Pressure, psig. | 16 | 16 |
| Oil contact time, sec. | 2 to 15 | 10 to 40 |
| Catalyst-oil ratio | 3 to 50 | 2 to 15 |
| Stage conversion, per cent by volume | 20 to 70 | 15 to 70 |
| Over - all two - stage conversion, per cent by vol. | 50 to 80 | |

Most of the pilot-plant operation, employing two separate units, was equivalent to parallel flow of catalyst—that is, freshly regenerated catalyst was used in each stage. In other experiments, series flow was employed; i.e., partially spent catalyst from the first stage was used in the second stage.

Several commercial equilibrium catalysts and a wide variety of commercial and experimental feed stocks were used in these studies. However, except where otherwise stated, the results presented in this paper were obtained with West Texas flashed distillate and equilibrium microspheroidal catalyst withdrawn from Shell's Houston refinery.

During the pilot plant investigation, several large batches of this catalyst and feed were used. The properties shown in Tables 1 and 2 are typical of the materials employed.

In addition to the development of cracking techniques and conditions used

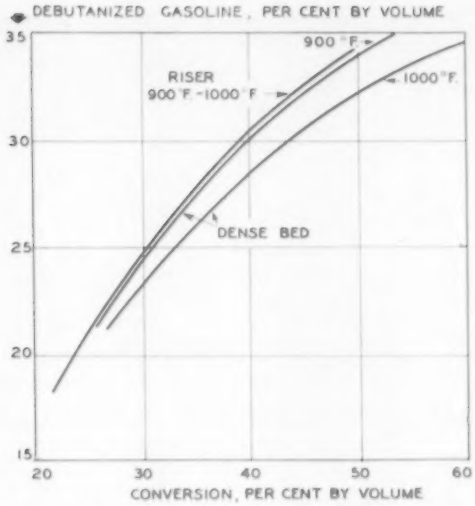
**TABLE 1—CATALYST PROPERTIES**

(Commercial equilibrium synthetic silica-alumina)

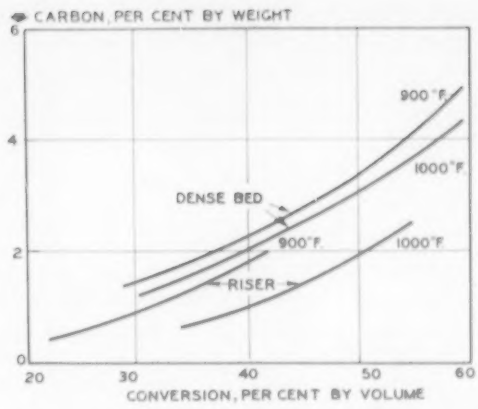
| | |
|---|---|
| Surface area, sq. m. per g. | 89 |
| Pore volume, ml. per g. | 0.25 |
| Particle-size distribution (by sedimentation, per cent by wt. (by microns): | |
| <40 | 6 |
| 40 to 50 | 12 |
| 50 to 60 | 19 |
| 60 to 70 | 18 |
| 70 to 80 | 15 |
| 80 to 90 | 12 |
| 90 to 100 | 9 |
| >100 | 9 |
| Contaminants analysis, per cent by wt.: | |
| Iron | 0.12 |
| Vanadium | 0.003 |
| Copper | 0.0012 |
| Nickel | 0.003 |
| Chromium | 0.0041 |

**TABLE 2—WEST TEXAS FEED-STOCK PROPERTIES**

| | |
|---|---|
| °A.P.I. | 29.1 |
| A.S.T.M. distillation, °F.: | |
| I.b.p. | 450 |
| 10 per cent by vol. | 540 |
| 50 per cent by vol. | 660 |
| Pour point, °F. | +70 |
| Ramsbottom carbon residue, per cent by wt. | 0.15 |
| Sulfur, per cent by wt. | 0.57 |
| Kinematic viscosity at 100° F., cs. | 13.5 |




**GASOLINE YIELDS from riser and conventional dense-bed cracking. Fig. 1.**




**CARBON YIELDS from riser and conventional dense-bed cracking. Fig. 2.**

in the two-stage process, the engineering aspects of fluidization, catalyst transport, catalyst-gas separation, stripping, and regeneration were investigated on pilot plant, semicommercial, and commercial scales.

These studies, which included the use of radioactive tracers and gamma-ray attenuation, involved detailed evaluation of the performance of six commercial units of varying designs. Stripper performance and the pressure drops and catalyst flow patterns in the standpipes and risers of these units were investigated extensively.

A semicommercial stripper and a semicommercial riser capable of transporting 1 ton of catalyst per minute were operated to develop novel designs and to provide data on stripping and on catalyst flow. These same units and others were also used to obtain data for design of the high-capacity cyclones required for the separation of first-stage products and the catalyst.

### Process Development

The upflow riser-reactor pilot plant operated as the first-stage reactor demonstrated the advantages that can be obtained from short-contact-time riser cracking vs. conventional fluid-bed cracking. The superiority of the riser technique is evident from Figs. 1 and 2, which show gasoline and carbon* yields, respectively, from riser and dense-bed cracking at both 900° and 1,000° F.

The advantage of the riser is magnified at the higher temperature. In riser cracking, the increase in temperature serves to decrease coke production without affecting gasoline yield, whereas an accompanying decrease in gasoline is experienced in dense-bed processing.

The superiority of the riser technique shown in Figs. 1 and 2 is the result of three factors: (1) establishment of uniform residence time and reduction of dilution of feed by cracked products due to the concurrent flow of catalyst and oil vapor, (2) better contacting efficiency between catalyst and oil, and (3) higher average catalyst activity.

These factors permit operation at high conversions with little destruction of cracked products, thereby resulting in lower coke and higher gasoline yields.

In addition to these benefits of riser

**TABLE 3—COMPARISON OF SINGLE-STAGE AND TWO-STAGE CRACKING OF VARIOUS FEED STOCKS**

| Crude source | West Texas | | | Redwater | | Los Angeles Basin | |
|---|---|---|---|---|---|---|---|
| Feed properties: | | | | | | | |
| A.P.I. gravity | 29.1 | | | 23.0 | | 25.2 | |
| Sulfur, per cent by weight | 0.57 | | | 0.70 | | 1.25 | |
| Ramsbottom carbon residue, per cent by weight | 0.15 | | | 1.0 | | 0.3 | |
| Precision distillation, per cent by volume: | | | | | | | |
| I.b.p. to 450° F. | 3 | | | 1 | | 1 | |
| 450° to 615° F. | 35 | | | 9 | | 27 | |
| 615° F.+ | 62 | | | 90 | | 72 | |
| | —Single-stage— | | | | | | |
| | Single pass | Total gas oil recycle* | Two-stage | Single-stage | Two-stage | Single-stage | Two-stage |
| Cracking temperatures, °F. | 900 | 900 | 1,000 to 900 | 900 | 1,000 to 900 | 1,000 | 1,000 to 950 |
| Catalytic cracking yields, per cent by vol.: | | | | | | | |
| Ethane and lighter (std. cu. ft. per bbl.) | (190) | (190) | (300) | (195) | (230) | (415) | (290) |
| Propylene | 7.6 | 7.1 | 9.5 | 4.9 | 7.5 | 6.4 | 7.8 |
| Propane | 4.2 | 3.8 | 3.8 | 3.2 | 2.9 | 3.9 | 3.7 |
| Butylenes | 8.2 | 8.8 | 10.9 | 7.0 | 8.8 | 8.1 | 9.0 |
| Isobutane | 9.4 | 8.3 | 4.5 | 5.8 | 3.9 | 3.8 | 4.6 |
| n-Butane | 1.8 | 1.5 | 1.5 | 1.1 | 0.8 | 1.1 | 0.9 |
| Amylenes | 4.8 | 5.5 | 6.6 | 4.9 | 7.6 | 5.2 | 6.4 |
| Isopentane | 6.5 | 6.9 | 3.8 | 4.5 | 2.6 | 2.0 | 2.5 |
| n-Pentane | 0.3 | 0.3 | 0.3 | 0.4 | 0.3 | 0.4 | 0.1 |
| Pepentanized gasoline (113° to 450° F.) | 24.2 | 32.2 | 37.5 | 33.5 | 41.9 | 28.8 | 38.6 |
| Light gas oil (450° to 615° F.) | 23.5 | 19.3 | 16.7 | 17.9 | 13.2 | 22.6 | 19.4 |
| Heavy gas oil (615° F.+) | 18.0 | 14.7 | 11.2 | 20.5 | 12.8 | 18.9 | 11.8 |
| Carbon, per cent by wt. | 5.2 | 5.2 | 5.2 | 8.5 | 8.5 | 6.5 | 6.5 |
| Conversion | 58.5 | 66.0 | 72.1 | 61.6 | 74.0 | 58.5 | 68.8 |
| Total yield of 10-lb. R.v.p. gasoline† | 49.9 | 59.5 | 67.4 | 55.5 | 67.7 | 50.8 | 64.8 |

*In this paper, carbon yield is reported for pilot plant experiments; and coke yield, including hydrogen associated with the carbon, is reported for commercial plant results.

*Total feed ÷ fresh feed = 1.6. †Based on polymerization of propylene and butylenes, and blending butane to 10-lb. R.v.p.

**TABLE 4—PROPERTIES OF PRODUCTS FROM TWO-STAGE AND CONVENTIONAL CATALYTICS CRACKING**

| | Single-stage | | |
|---|---|---|---|
| | Single pass | Recycle | Two-stage |
| Carbon yield, per cent by weight | 5.2 | 5.2 | 5.2 |
| Conversion, per cent by volume | 59 | 66 | 72 |
| Product properties: | | | |
| Depentanized gasoline: | | | |
| °A.P.I. gravity | 45.5 | 46.3 | 46.0 |
| Sulfur, per cent by weight | 0.08 | 0.08 | 0.14 |
| Maleic anhydride value | 8 | 7 | 18 |
| Hydrocarbon type analysis, per cent by weight: | | | |
| Olefins | 16 | 26 | 43 |
| Aromatics | 50 | 44 | 37 |
| Saturates | 34 | 30 | 20 |
| Octane ratings (neat): | | | |
| Research method +3 cc. TEL | 98 | 98 | 98.5 |
| Light gas oil: | | | |
| °A.P.I. gravity | 28.0 | 27.3 | 26 |
| Aniline point, °F. | 123 | 116 | 113 |
| Kinematic viscosity at 100° F., cs. | 3.2 | 3.1 | 3.0 |
| C.F.R. calculated cetane number | 37 | 35 | 32 |
| Heavy gas oil: | | | |
| °A.P.I. gravity | 23.5 | 22 | 20 |
| Ramsbottom carbon residue, per cent by weight | 0.8 | 0.3 | 0.7 |
| Kinematic viscosity at 130° F., cs. | 14 | 13 | 13 |

cracking, it was also found that the over-all severity for achieving high conversions (70 per cent and higher) could be kept much lower in two-stage cracking. This is the result of processing the more refractory gas oil from first-stage cracking in the absence of the diluent gas and gasoline produced up to the first-stage conversion level.

**Temperature catalyst flow . . .** A detailed study of the effect of temperature variations in the two reaction stages was made. From the various possibilities, a higher riser (first-stage) temperature and lower second-stage temperature was chosen.

This temperature sequence is obtained commercially with series flow of catalyst from the first to second reactor stage. Pilot-plant experiments in which series flow of catalyst was employed showed that the low level of coke deposited on the catalyst in the first stage has no effect on product distribution in the second stage.

**First-stage conversion . . .** The pilot-plant studies showed that the optimum first-stage conversion level was primarily dependent upon feed-stock quality and dependent to a lesser extent on total conversion and temperature sequence. The over-all catalytically cracked gasoline yield obtainable peaks rather sharply at a particular first-stage conversion for any given feed and coke make.

The first-stage conversion which leads to a maximum gasoline may not be optimum from an economic standpoint, of course, depending on the downstream processing facilities: for example, polymerization vs. alkylation of olefins, the marketing situation, and other factors.

Economic evaluations using typical product values showed that first-stage operation at conversions differing somewhat from optimum does not incur significant economic penalties. This is an important consideration in process flexibility.

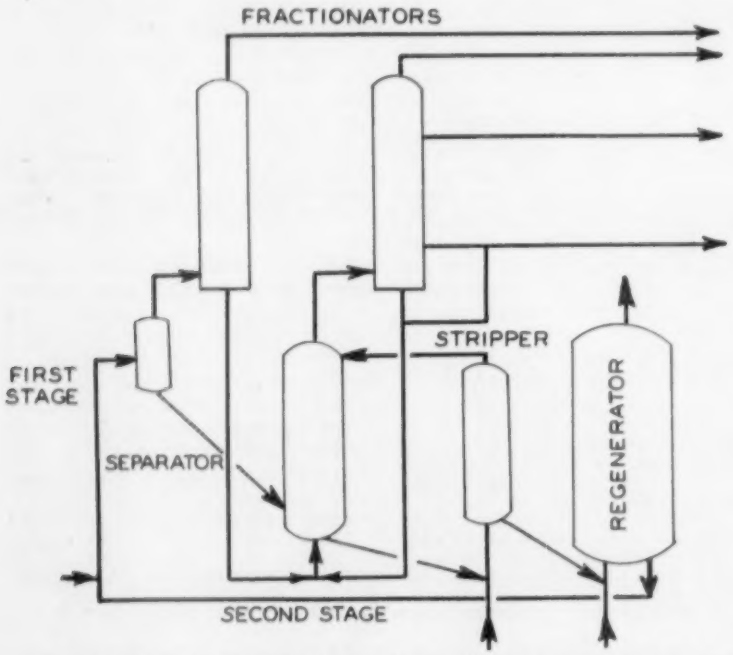
**Varying feed stocks . . .** Several commercial and experimental stocks were investigated. Comparisons for some of these feeds are summarized in Table 3. With the West Texas feed, two-stage cracking permits the highest conversion at constant carbon yield; conventional recycle operation gives yields intermediate between those from single-stage and two-stage cracking. Similar results are obtained with other feeds of widely differing quality, as indicated by the single vs. two-stage comparisons for Redwater and Los Angeles Basin flash distillates shown in Table 3.

The differences in the yields of gaseous hydrocarbons are due in part to the cracking temperatures employed in the comparisons and in part to the processing techniques. At constant temperature and conversion, less dry gas is produced in riser cracking than in dense-bed operation, but the trend of increasing gas production as temperature is raised holds with either method of operation.

These two factors explain the increased gas make for the two-stage cracking results shown for West Texas and Redwater compared to single-stage cracking at 900° F., and the decreased gas make for Los Angeles Basin compared to single-stage operation at 1,000° F.

**Product quality . . .** The major differences in quality of the products from conventional single-stage and the present two-stage cracking process are in the compositions of the gasolines as shown in Table 4. The properties of the final gas oils produced by the two techniques are essentially the same when compared at constant conversion. The differences which do not exist can be explained largely on the basis of the different conversions obtained at a given coke yield.

Despite the large variations in the compositions of the gasolines produced in the various processes, the leaded research method octane rating of these gasolines are essentially the same. The calculated research method +3 cc. TEL




**SCHEMATIC FLOW DIAGRAM of Shell's Anacortes catalytic cracking unit. Fig. 3.**

ratings of the total 10 lb. R.v.p. gasolines from all the processes fall in the range 100.0 to 100.5 octane number.

The higher olefin and lower aromatic content of two-stage gasoline result from the fact that a very substantial portion of the gasoline is produced in the first stage where the conditions are such that olefin saturation and recracking are avoided. While the total amount of aromatics in the various gasolines does not vary widely, the concentrations of aromatics in two-stage gasoline is much lower due to the increased amount of olefins produced.

The somewhat higher sulfur content of two-stage gasoline is also attributed to avoidance of recracking. This increase in sulfur does not present a serious problem with most United States crudes; however, special treating techniques will probably be required with some high-sulfur crudes.

Because of the high olefin content and the relatively high diolefin content, extensive stability tests, including an 18-month storage program, were carried out. Since the first-stage gasoline would be expected to be the least stable portion of the total gasoline, it was used in these tests rather than the combined two-stage gasoline. The results of the storage program indicated that the first-stage gasoline, when properly inhibited initially, is as stable as conventional catalytically cracked gasoline.

Engine cleanliness tests were also carried out on the first-stage gasoline. The results of these tests showed that this gasoline is comparable to a typical commercial premium gasoline. The stability of first-stage (and therefore two-stage) gasoline, despite the rather high diolefin content, is attributed primarily to the boiling range of the diolefins. Analysis of several fractions of the gasoline showed that the diolefins are concentrated in the lower boiling portion, which do not contribute markedly to gum formation.

**Flexibility . . .** Considerable flexibility is available for changing the yield structure from any given feed stock. For example, gasoline yield can be increased further by incorporating recycle into one of the cracking stages. On the other hand, in periods of high demand for intermediates, the yield of light gas oil can be increased substantially by charging only heavy gas oil to the second stage.

A comparison of two types of two-stage operation, namely, with total first-stage gas oil and with heavy first-stage gas oil only going to the second stage, is shown in Table 5. These data are on the same basis (5.2 per cent by weight carbon) as, and therefore comparable with, the West Texas data given in Table 3. The 9 per cent increase in light gas-oil yield is realized partly at the expense of heavy gas oil and part-

**TABLE 5—TWO-STAGE YIELDS FROM CRACKING TOTAL FIRST-STAGE GAS OIL VERSUS HEAVY FIRST-STAGE GAS OIL IN THE SECOND STAGE**

| | Second-stage feed— | |
|---|---|---|
| | Total gas oil* | Heavy gas oil† |
| Total conversion, per cent by volume | 72 | 67 |
| Yields, per cent by volume: | | |
| Debutanized gasoline (i.b.p. to 450° F.) | 48.2 | 43.8 |
| Light gas oil (450° to 615° F.) | 16.7 | 25.8 |
| Heavy gas oil (615° F.+) | 11.2 | 7.6 |
| Carbon, per cent by weight | 5.2 | 5.2 |
| Total 10-lb. R.v.p. gasoline, per cent by volume‡ | 67.4 | 62.7 |

*Total feed to both stages ÷ fresh feed = 1.6. †Total feed to both stages ÷ fresh feed = 1.3. ‡Based on polymerization of propylene and butylenes, and blending butane to 10-lb. R.v.p.

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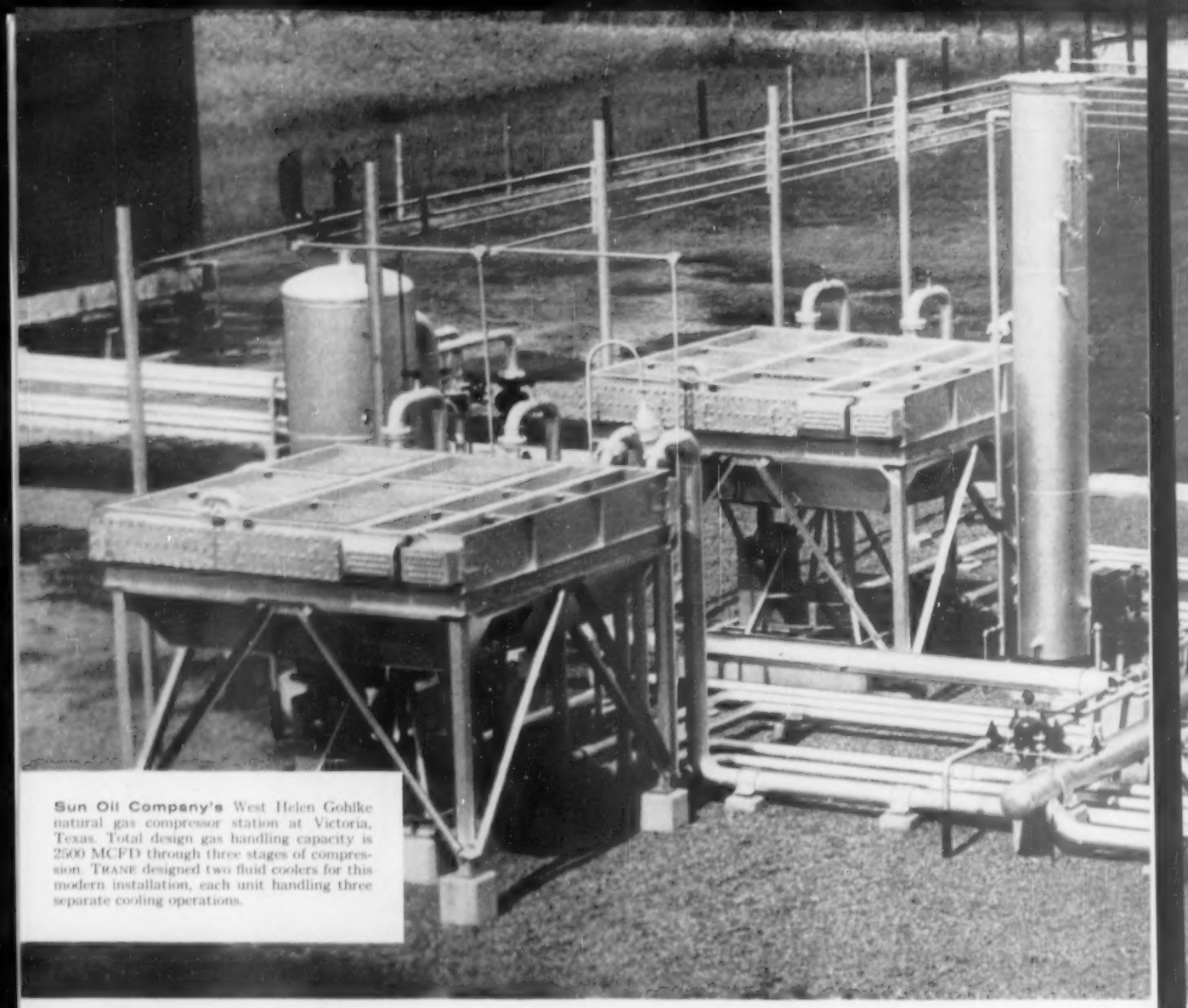

**Sun Oil Company's** West Helen Gohlke natural gas compressor station at Victoria, Texas. Total design gas handling capacity is 2500 MCFD through three stages of compression. TRANE designed two fluid coolers for this modern installation, each unit handling three separate cooling operations.

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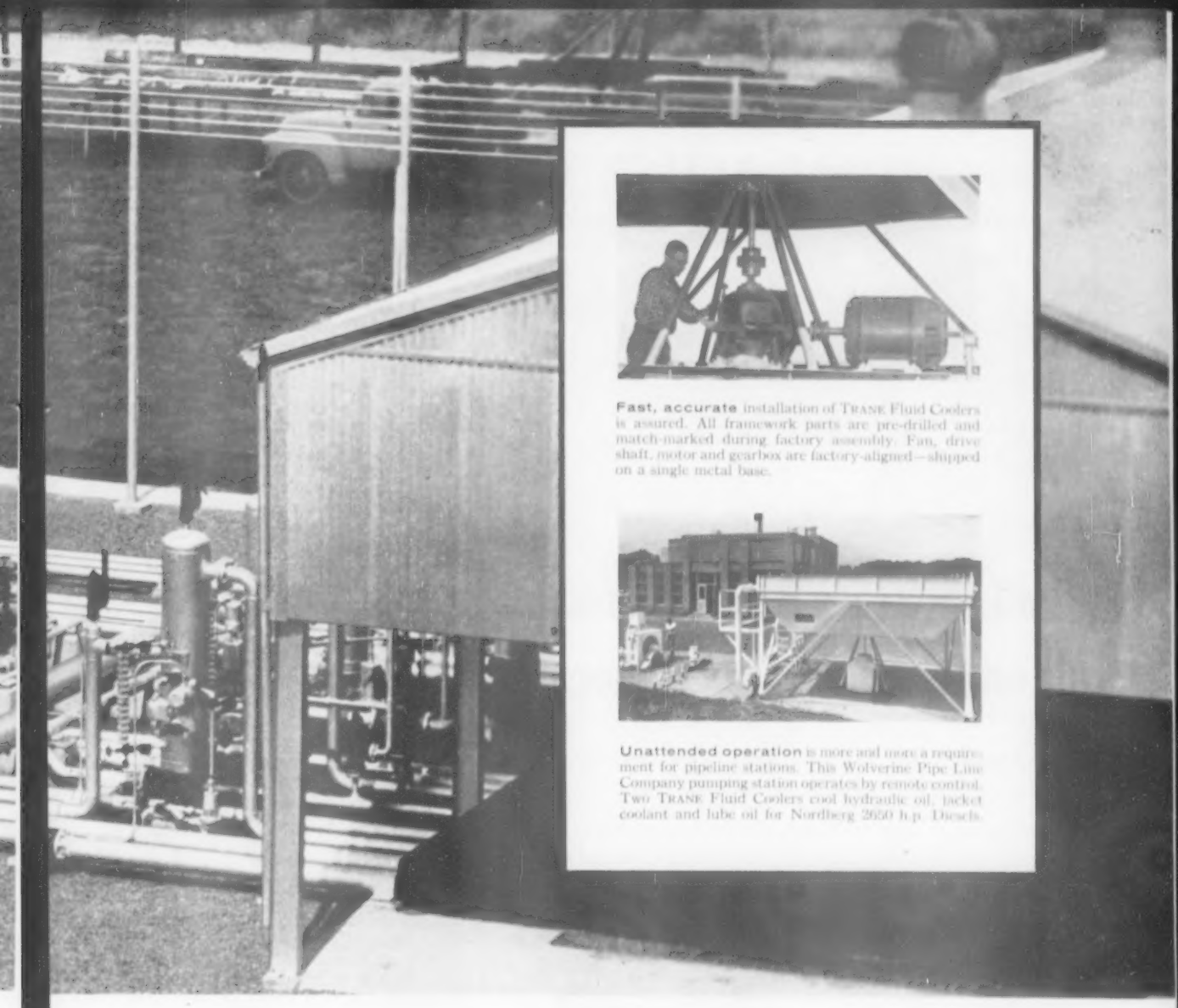
**All three operations** were incorporated by TRANE in one compact fluid cooler package. *One* unit solved *three* major cooling jobs! Header design on the high pressure coils meets all API-ASME code requirements for unfired pressure vessels. Also, coil tubes are cleanable, with





**Fast, accurate** installation of TRANE Fluid Coolers is assured. All framework parts are pre-drilled and match-marked during factory assembly. Fan, drive shaft, motor and gearbox are factory-aligned—shipped on a single metal base.



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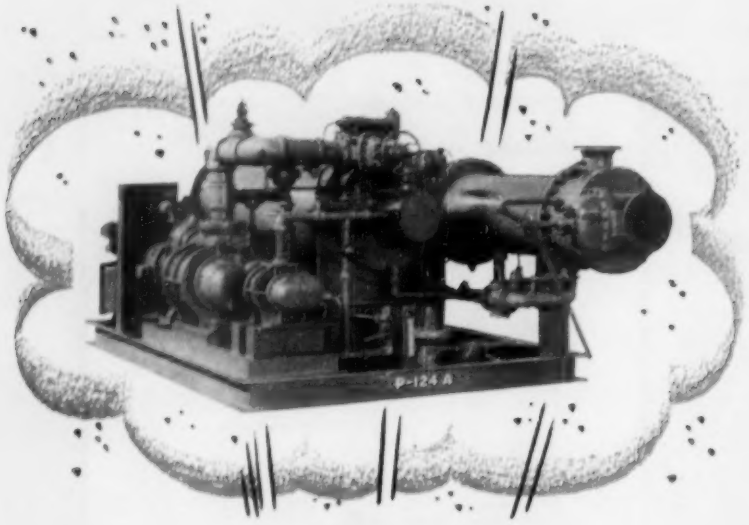

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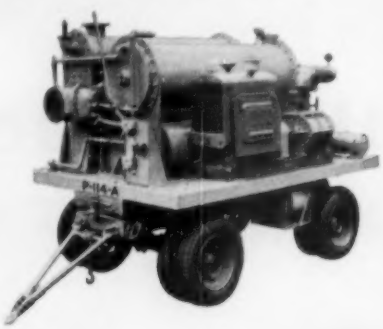

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## Natural Gas—Gas Pipelines

ly because of the lower total conversion.

However, despite the increased light-gas-oil yield and the 5 per cent lower conversion, the gasoline yield is decreased only 4 per cent. Furthermore, the light gas oil produced in this way is of high quality. Of course, gains in yield and quality could be achieved in conventional recycle operation by recycling only heavy gas oil, but the difference between comparable two-stage cracking and recycle cracking operations would be essentially the same as that shown in Table 3.

It is significant, however, that the two-stage process operated for maximum intermediates rather than maximum gasoline, i.e., cracking of only heavy gas oil in the second stage, produces 3 per cent more gasoline than conventional recycle cracking of total gas oil at roughly the same total conversion.

**Engineering features . . .** Extensive experimentation on equipment of sizes ranging from small laboratory units to commercial plants demonstrated the practicality of all new features of two-stage designs. In particular, the characteristics of catalyst-oil-vapor riser flow and of high-load separation devices were established over very wide ranges of operating conditions. These studies have shown that practical designs can be made to cover a wide scope of operating requirements.

Additionally, as a result of Shell's research, there have been significant advances in stripping and regeneration techniques in the past few years. Some of these improvements were previously incorporated and tested in other Shell catalytic cracking units. The Anacortes design incorporates these desirable features, plus other new developments, in the process flow.

### Anacortes Unit

The first commercial unit employing these new techniques was built at Shell's refinery at Anacortes, Wash. A schematic flow diagram of this unit is given in Fig. 3. Fresh feed is contacted in a riser reactor with regenerated catalyst.

The product vapors and partially spent catalyst are separated, the former going to a fractionator and the latter routed to the second-stage reactor to which gas oil from the first-stage fractionator is fed. Spent catalyst is stripped, regenerated, and returned to the riser reactor.

The unit has operated on a mixture of Alberta feeds since its startup in January. Typical feed-stock properties are shown in Table 6. Plant yields with

this feed mixture are given in Table 7.

The plant exceeded design expectations and has demonstrated ability to operate smoothly without mechanical problems of any consequence.

**TABLE 6—ALBERTA FEED-STOCK PROPERTIES**

| | |
|---|---|
| °A.P.I. gravity | 23.7 |
| A.S.T.M. distillation, °F.: | |
| I.b.p. | 508 |
| 10 per cent by volume | 620 |
| Pour point, °F. | +85 |
| Ramsbottom carbon residue, per cent by weight | 0.83 |
| Sulfur, per cent by weight | 1.26 |
| Viscosity at 210° F. S.s.U. | 51 |

**TABLE 7—CATALYTIC CRACKING OF MIXED ALBERTA FEED STOCK AT ANACORTES**

| | Yields (per cent by volume) |
|---|---|
| Ethane and lighter (std. cu. ft. per bbl.) | (340) |
| Propylene | 8.0 |
| Propane | 4.5 |
| Butylenes | 12.7 |
| Butanes | 5.1 |
| Debutanized gasoline | 53.3 |
| Light gas oil | 12.2 |
| Heavy gas oil | 12.4 |
| Coke, per cent by weight | 6.5 |
| Conversion | 75.4 |

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It was decided to clean and coat the line, and that the coated section would be considered a test of the IPM process.

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Contamination Index—2

# Determining the Contamination Index

by J. J. Watt,* B. G. Martin,† and W. H. Still*

THIS method describes a procedure for detecting contamination of distillate burning oils with gasoline. The Contamination Index can be correlated with the Tag C. T. flash point if the volatility of the gasoline is known.

**Outline of method . . .** A combustible gas indicator is used to quantitatively determine the volatile vapors evolved from a sample of distillate burning oil under prescribed conditions. The reading obtained may be converted by graph to a Tag C. T. flash point.

**Apparatus . . .** A combustible gas indicator calibrated to read directly the lower explosive limit of n-pentane; the inlet hose to the meter must resist absorption of hydrocarbons and be less than 4 ft. long. Pint bottle, clean, dry, with stopper.

### Procedure

1. Flush the indicator and sampling line with fresh air by squeezing the aspirator bulb several times.

2. Check the operation and calibration of the instrument according to the directions provided by the manufacturer. This normally includes checking the zero reading of the meter and making any required adjustment. The condition of the batteries and circuit is checked by making a voltage check in the manner described by the manufacturer.*

3. Half-fill a clean, dry pint bottle with a representative sample from the tank or line to be tested.

4. Stopper the bottle tightly. Shake it vigorously to vaporize the volatile components of the sample.

5. Stand the bottle on a level platform where it will not be subject to sudden temperature changes.

6. Unstopper the bottle and immediately insert the end of the inlet tube through the neck of the bottle. The end of the tube should be within 1 in. of the liquid. Do not permit the tube to touch the sample in the bottle. Oil or foam are not permitted in the instrument.

7. Aspirate the sample through the indicator and read the maximum deflection of the meter. This reading is the Contamination Index. Only one determination should be made on each sample. If the result is to be checked, a new sample must be used. Record the temperature of the sample immediately.

8. To obtain the estimated Tag C. T. flash point, refer the Contamination Index and the sample temperature to the correlation chart (see Figs. 1 to 4).

*The meter should be periodically and carefully standardized against normal pentane.

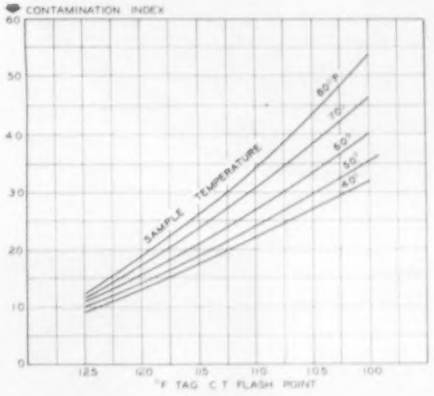



FIG. 1—Correlation between Contamination Index and Tag C.T. Flash for 130° F. flash-point distillate burning oils contaminated with 9-lb. R.v.p. gasoline.

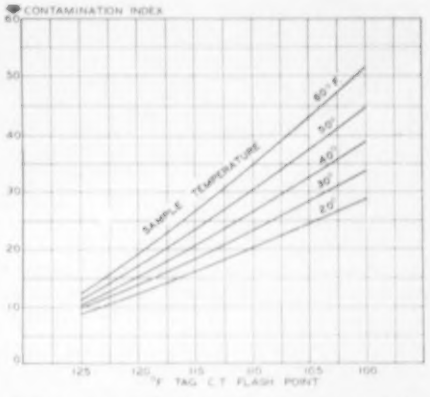



FIG. 2—Correlation between Contamination Index and Tag C.T. Flash for 130° F. flash-point distillate burning oils contaminated with 12-lb. R.v.p. gasoline.

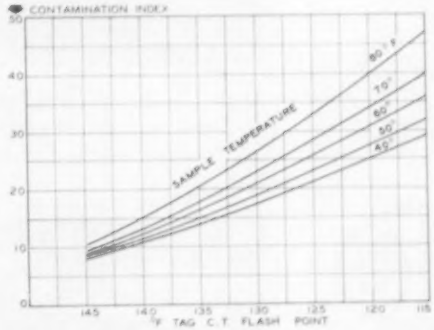



FIG. 3—Correlation between Contamination Index and Tag C.T. Flash for 150° flash-point distillate burning oils contaminated with 9-lb. R.v.p. gasoline.

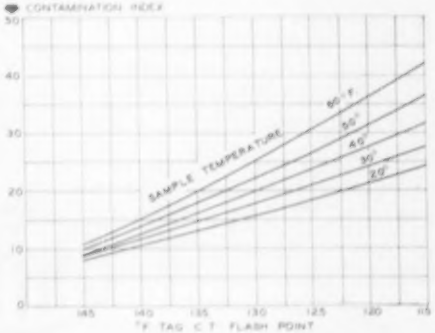
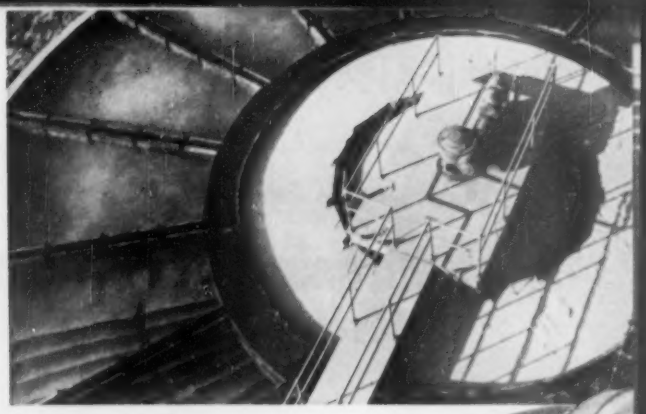



FIG. 4—Correlation between Contamination Index and Tag C.T. Flash for 150° F. flash-point distillate burning oils contaminated with 12-lb. R.v.p. gasoline.

*Production control department and †Sales operations division, domestic marketing department, Atlantic Refining Co., Philadelphia.

# INFILCO high-rate treatment equipment is the sure cure for "oil in troubled waters"



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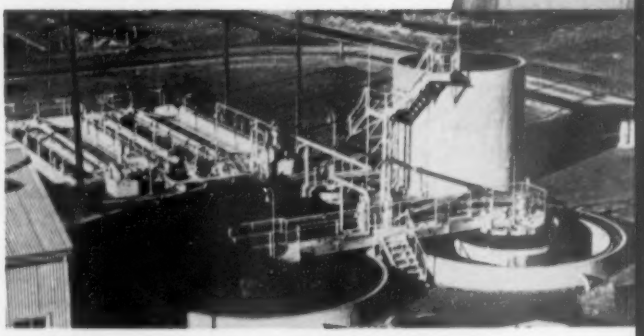
Faced with a disposal problem for oily and other types of industrial waste waters?

Accelerated treatment of such wastes has been a prime objective of INFILCO for over 60 years. You will find INFILCO equipment, with many exclusive features, includes the most efficient, compact units on the market today. Whatever your need, there is *high-rate* INFILCO equipment to meet it. Here are typical examples. You can depend on these units to—

- ***require much less space***
- ***provide uniform and flexible treatment***

It will pay you to consult INFILCO about waste problems because INFILCO KNOWS HOW to help you solve them. Write today for complete information.

Inquiries are invited on all waste treatment problems.



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**High-rate flotation equipment.** SEDIFLOTOR® air flotation clarifiers offer new efficiency for rapid removal of oil, greases and light suspended solids. *Bulletin 6051. OG-28.*

8810

# How Today's Portable Gasoline Plants Operate—3

**by Otha H. Grimes**

THE Stroud plant uses a minimum number of pumps. The lean-oil pump is an engine-driven reciprocating power pump. The reabsorber rich-oil pump and the still-reflux pump are electric-motor-driven centrifugal pumps. The remainder of the process pumps are reciprocating pumps of the "steam pump" type. After being heated in a hot-lean-oil exchanger, fuel gas instead of steam is used as power gas to operate these pumps.

The control instruments are mounted on the skid and near the control points. A central instrument board is not used. The skid unit is now enclosed in a building with the towers projecting through the roof. The vessels are placed quite close together but the equipment is so arranged that it is all accessible from one side or the other of the skid. The skids were moved to the job with all possible equipment and piping in place.

Author is in the natural-gasoline business in Tulsa. Paper presented at annual N.G.A.A. meeting, Fort Worth, April 13.

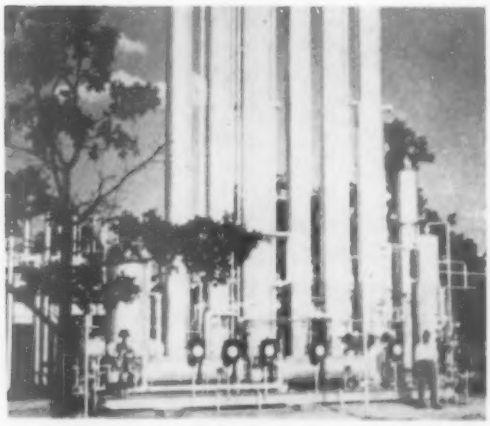
The towers, of course, were not shipped on the skids. The tower piping, however, was prefabricated and lines on the towers were erected with the towers. The process tanks —such as scrubbers, reflux separators, flash tanks, etc., are stacked two or three high. Tanks requiring elevation for pump suction head, such as reflux tanks are on top; the bottom tanks are limited to such services as gas scrubbers, oil settlers, etc., where no pump suction problems are involved. The reboilers are placed lengthwise on the skid on either side of the towers as space permits.

Such plants are functionally complete and may be tailor-made for any recovery efficiency justified by the economics of the particular project. They are about as compact, and easy to operate as an efficient plant can be.

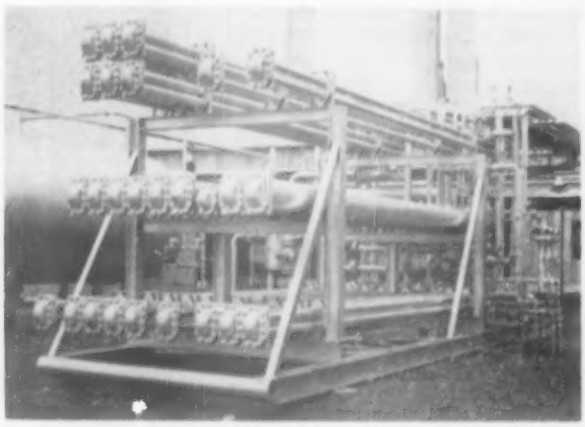
**Costs . . .** It is comparatively easy to determine the cost of the more-or-less-standardized skid units. These units can be purchased by the operator on a fixed-price basis. The field costs can be predetermined with fair accuracy, since very little material is required beyond the skid units — principally simple foundations and a little interconnecting piping.

Any errors in the estimated field costs constitute only a small percentage of the total cost. The accuracy with which the over-all cost of a project can be predicted is an important factor in the popularity of these because the economics of the project is better known in advance.

It is obvious from the description and illustrations that the salvage value of these plants is extermely high. This makes the plants much more desirable for the shorter-lived projects than are those of the more conventional type of construction. Not only is the equipment salvageable, but so also is practically all of the piping and most of the piping labor.



**THIS MIDGET PLANT, located at Stroud, Okla., has all the pressure vessels mounted on a single skid.**



**HEAT-EXCHANGE EQUIPMENT at the Stroud plant, except for reboilers, is separately skid mounted.**

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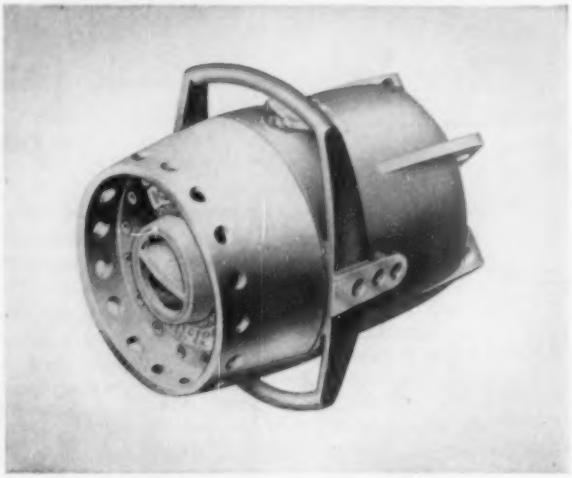
## a portable tool for low-cost radiography



Here is a new development employing radioactive cobalt, iridium, or cesium as a source of gamma rays. One of the most practical means yet devised for industrial non-destructive testing, the KEL-RAY Projector lowers costs and simplifies procedures wherever radiographic testing can be applied. Here's why:

**PORTABLE** – Requiring no external power, the KEL-RAY Projector is available in three portable sizes, the smallest of which can be moved by hand.

**SAFE** – Ruggedly constructed, equipped with tamper-proof shutter, it is designed and built to keep radiation leakage at a minimum – well below AEC and ICC safety requirements.

**ECONOMICAL** – Initial and operating costs are low. Requires no maintenance during life of isotope. Set-up time and man-power are minimized.

**EASY TO USE** – Simple to operate on light or heavy material up to 8 inches thick by anyone properly trained.

*For information on how the KEL-RAY Projector can meet your needs, write for Bulletin P196F.*

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JOB IMPROVEMENT FOR THE PROCESS FOREMAN—52

# The A, B, C's of Instrumentation—5

IN practical temperature-indicating instruments, the millivoltmeter shown in Fig. 27 (see last installment) is replaced with a galvanometer. A galvanometer is an instrument which indicates a flow of current and its direction. A simplified form of a temperature indicating device is shown in Fig. 29.

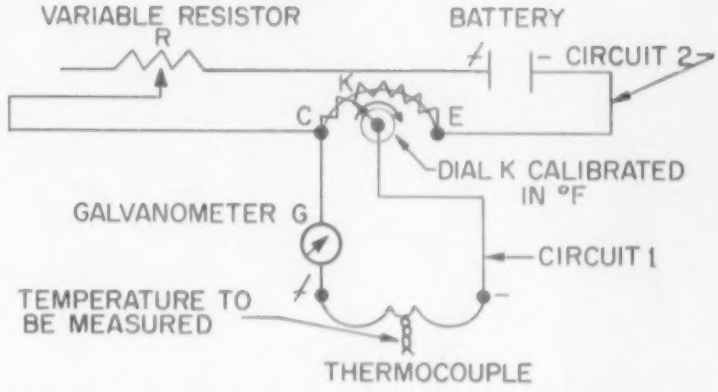
The current in Circuit 2 (Fig. 29) is fixed by the position of Variable Resistor R (within the instrument). Variable Registor R has been set using a standard cell, generating a standard voltage. The voltage across the terminals, C and K, is proportional to the length of the Resistor C K. The length of C K, of course, depends upon the position of the movable arm of K (current) in Circuit 1 flows due to the voltage generated by the hot junction of the thermocouple.

In using the instrument to measure a temperature, Dial K is rotated until the galvanometer (G) reads zero. This means that no current is flowing. The voltage across Circuit 2 has been adjusted by length of C K so that it exactly nullifies that generated by the thermocouple in Circuit 1. The temperature at the thermocouple hot junction is read on Dial K (degrees Fahrenheit).

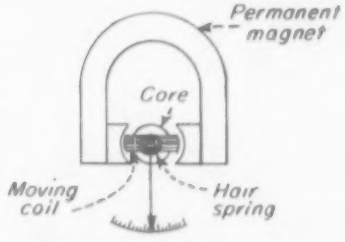
A temperature-recording device operates in the same way, expect that when an unbalanced voltage exists, the small current in Circuit 1 creates an unbalance. This in turn starts a motor moving Dial K toward a balanced condition.

The compensating device mentioned previously is omitted in Figs. 27 and 29 for simplification. Inasmuch as the thermocouple measures a temperature difference between the two junctions, in order to get accurate temperature readings at the hot junction, it is necessary to maintain the cold junction at a constant temperature — or compensate for any temperature variation. These devices take care of these variations.

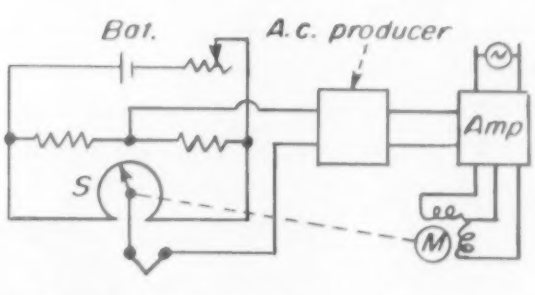
The millivoltmeter (Fig. 30), while used where cost and simplicity are greater factors than accuracy, has been superseded by precision potentiometers. Using the same basic instrument as the resistance thermometer, the early mechanical models (Fig. 31), with galvanometers and many moving parts, have been replaced by the electronic models (Fig. 32), without galvanometers and with less moving parts.



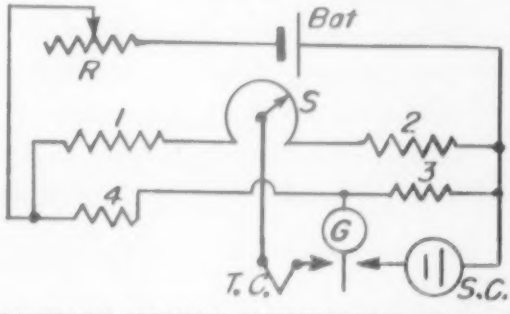

**TEMPERATURE-MEASURING CIRCUIT** shows various components necessary in a thermocouple system. Fig. 29.




**MILLIVOLTMETER** is used where cost and simplicity are greater factors than accuracy. Fig. 30.

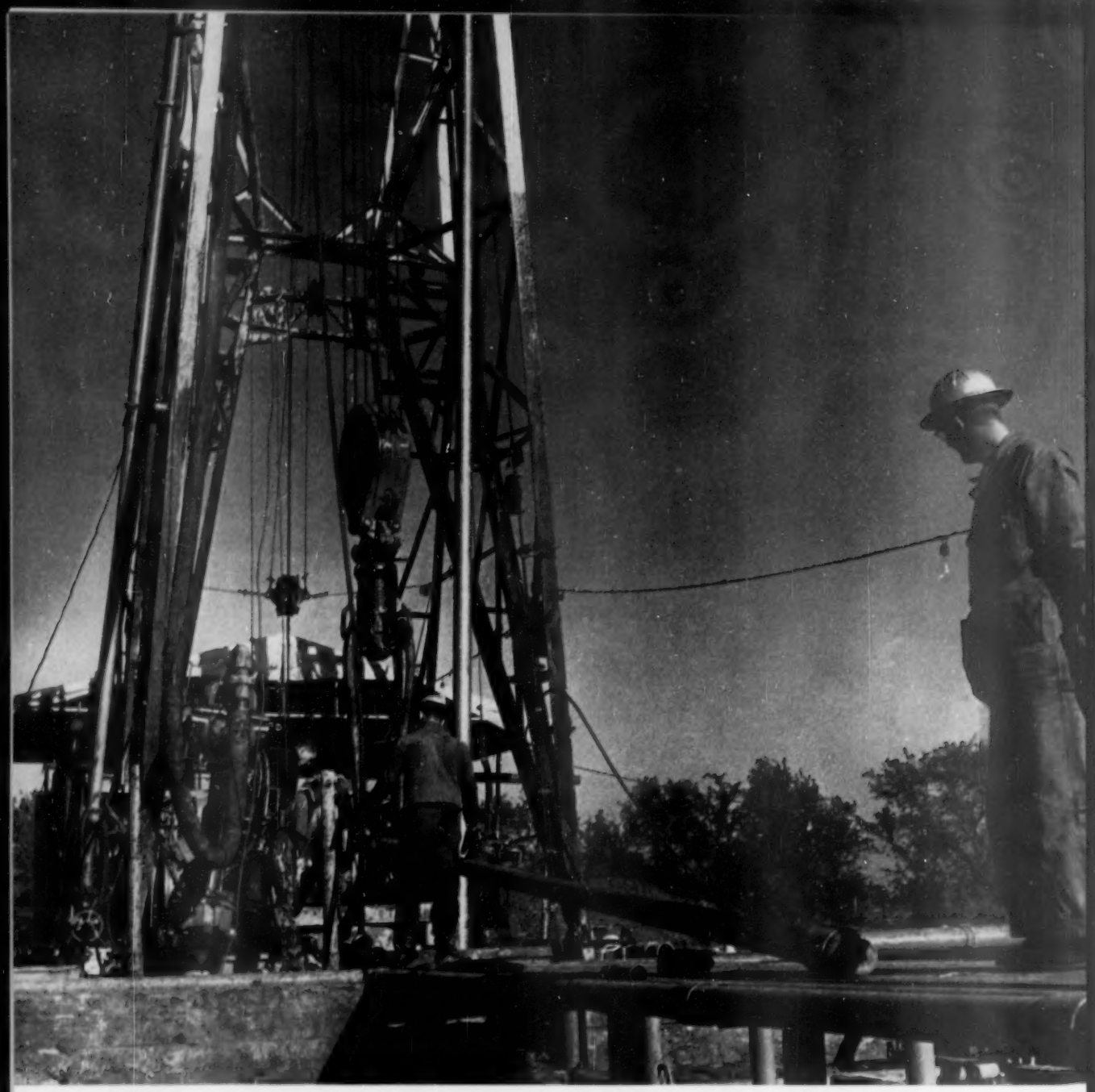



**EARLY MECHANICAL MODEL** of precision potentiometer uses galvanometers and other moving parts. Fig. 31.




**ELECTRONIC PRECISION POTENTIOMETER** without galvanometers and with few moving parts is now available for use. Fig. 32.

This material is taken from "Fundamentals of Refining," operating manual of Magnolia Petroleum Co., refining division, Beaumont, Tex.



**Wire Rope at Work**—This crew struck oil in the Gladys Pool, Sedgwick County, Kansas, and here you see them about to run a drill-stem test. The well had reached 3195 ft; at that point it was in Mississippi dolomite. The Laura Jane Oil Company, owned by D. M. Shawver, drilled the hole and planned to produce and sell the crude.

One of the hardest-working components of the drilling rig was a Bethlehem Purple Strand rotary line. A Form-Set (preformed) rope, it had seen active duty on a number of previous jobs. This was its twelfth, with others to come; for the rope was in excellent shape, and gave promise of living to a ripe old age.

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by W. L. Nelson
Technical Editor

COST-imating

# 12. Prices of Pipe Stills

COST INDEXES OF STILLS AND RELATED MATERIALS (1946 = 100)[2,4]

| | Boiler tubes | Fire brick | Pipe stills* | Steam power† materials | Labor, refinery construction[4] | Nelson Index[4] |
|---|---|---|---|---|---|---|
| 1946 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1947 | 115 | 114 | 114 | 122 | 113 | 117 |
| 1948 | 135 | 133 | 135 | 132 | 128 | 132.5 |
| 1949 | 141 | 140 | 141 | 132 | 137 | 139.7 |
| 1950 | 150 | 153 | 151 | 137 | 144 | 146.2 |
| 1951 | 163 | 165 | 163 | 146 | 152 | 157.2 |
| 1952 | 169 | 167 | 172 | 147 | 163 | 163.6 |
| 1953 | 188 | 182 | 184 | 149 | 174 | 173.5 |
| 1954 | 199 | 193 | 193 | 151 | 183 | 179.8 |
| 1955 est. | 205 | 200 | 200 | 153 | 190 | 184.5 |

*Composite for tubing, headers, brick, structural steel, steel castings and labor.
†Marshall & Stevens materials (only) index, Chem. Engineering, March 1955, p. 178.

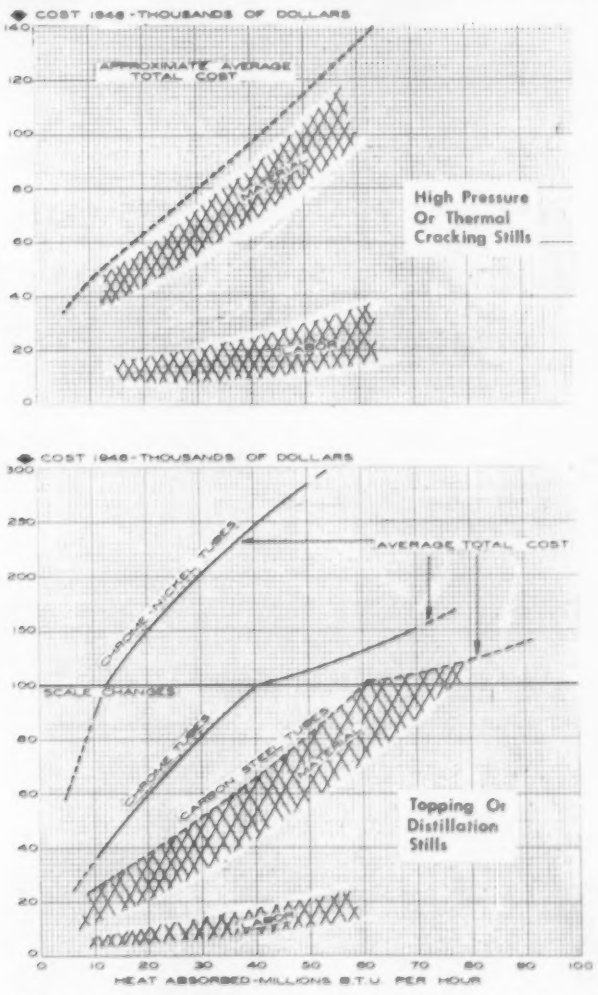


Fig. 1—Approximate 1946 Cost of Pipe Stills.[1,3] Short stacks are included in the cost of upflow stills but the large stacks needed for the other types of stills are not included.

THE use of longer tubes[1] which saves much on the cost of bends or headers has resulted in sharp decreases in the cost of pipe stills. Most economical tube lengths[2] are indicated in Table 1. Likewise, upflow stills and a generally lighter construction are being employed. Thus, the low prices shown in Fig. 1 apply to the newer light constructions and the highest prices to older down-convection types of stills and especially the use of suspended walls. Likewise, the small shop-assembled (200,000 to 6,000,000-B.t.u.) stills now available are even cheaper than the tailor-made stills indicated in Fig. 1.

The cost of return bends, tubes, bolts, gaskets, etc., has been discussed in an early issue of the Cost-imating Series (Tubes and Bends, The Oil and Gas Journal, April 21, 1949, p. 243).

TABLE 1 — ECONOMICAL TUBE LENGTH,[3] FT.

| Heat absorption M.M.-B.t.u. per hr. | Simple down convection | Modern down convection | Straight-up types* | |
|---|---|---|---|---|
| | | | Small | Large |
| 10 | 30 | 20 | 23 | |
| 20 | 50 | 41 | 35 | 25 |
| 30 | 70 | 62 | 46 | 31 |
| 40 | 88 | 80 | | 37 |
| 60 | | | | 46 |

*Probably applies with reasonable accuracy to all similar types.

### References

1. Nelson, W. L., Petroleum Refinery Engineering, 3rd Ed., p. 767, McGraw-Hill Book Co., Inc., New York, 1949.
2. Nelson, W. L., Tubes and Bends, The Oil and Gas Journal, April 21, 1949, p. 243.
3. Nelson, W. L., Pipe Stills, The Oil and Gas Journal, April 7, 1949, p. 109.
4. The Nelson Refinery Construction Cost Index, The Oil and Gas Journal, July 7, 1952, p. 105. (The Nelson Index also appears in the first issue each month.)
5. Chilton, C. H., Chem. Engineering, June 1949, p. 97.
6. Author's personal files.

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"When I want a **4-CUTTER BIT**

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## Among the

# Drilling Contractors

**O'Neal-Garvin Drilling Co.** has contracted for a deep, geological wildcat test to be drilled for Continental Oil Co. in the shallow Ponca City field, in Kay County, northern Oklahoma. The test, 1-A Brett, in 8-25n-2e, will be drilled to granite, or 5,300 ft., whichever is first.

**Joe S. Jackson** is contractor on a rank wildcat test Gordon F. Samuel, of Sapulpa, Okla., is starting in northern Arkansas. Location listed as 1 Brown, in 1-18n-21w, is 3 miles southeast of Bataria and about the same distance northwest of Harrison, in Boone County. Plans call for a 3,000-ft. objective.

**Natchez Drilling Co.** has taken a contract for a projected 5,900-ft. test a mile southeast of Golden Meadow field, in Lafourche Parish, southeastern Louisiana. E. C. Wentworth is operator. The test is his 1 Lafourche Realty, in 17-19s-22e.

**Circle Drilling Co.,** Lake Charles, La., is under contract to Bel Oil Corp. for a Cockfield test to be drilled a mile southeast of South Oberlin field, in Allen Parish, southern Louisiana. Location is at 1 Unit C, in 2-6s-4w.

**Loffland Brothers Co.,** Tulsa, will drill Shell Oil Co.'s next test in the Loisel area, south of Fausse Pointe field, in Iberia Parish, southern Louisiana. The test, 2 State Lease 2489, will be Shell's third attempt to confirm production it discovered in the area last August. Shell's discovery well produced gas and condensate from a 12,760-ft. sand. Two tests since then have been failures.

**M & M Drilling Co.,** Houston, is scheduled for a deep wildcat test to be drilled for Freeport Oil Co. in the narrow gap between Bosco and Cankton fields, in the south tip of St. Landry Parish, southern Louisiana. Location, at 1 Richard, in 22-8s-3e, is about a mile northeast of the former field, and about the same distance west of Cankton production. Hole is projected to 12,500 ft.

**Richard Drilling Co.** has a rig running for Delange, Neatherly & Schimmel in the Speaks area, 8 miles south of Vienna, in eastern Lavaca County, South Texas. It now is on a 9,000-ft. test, 1 Karney, in the Nicholas Martinez Survey.

**Jett Drilling Co., Shreveport,** is contractor, and a joint operator with E. F. Neely, also of Shreveport, in the drilling of a 7,000-ft. Wilcox test in Rapides Parish, southern Louisiana. Its location, 1 Joseph Smith, in 15-4n-1e, is 10 miles northeast of Latneir.

**Wilson Drilling Co.,** Jackson, Miss., has a new contract operation in Wilkinson County, southwestern Mississippi. It is an 8,000-ft. wildcat test for Calto Oil Co., G. W. Gulmon, and Louis Alford. Location, at 1 Netterville, in

**Sam L. Tennant (left), owner of Tennant Drilling Co., Blackwell, Okla., and some of his crew on a rig his company is running under contract for Parker Petroleum Co. in the Braman area, north of Blackell, in northwestern Kay County, Oklahoma. Crewmen, left to right, are: Dan Logue (driller), Earl Miller, Jack Parcher, and Russell Booth.**


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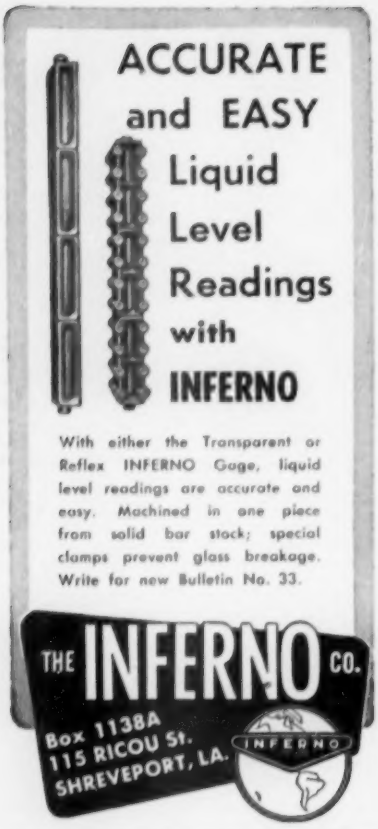
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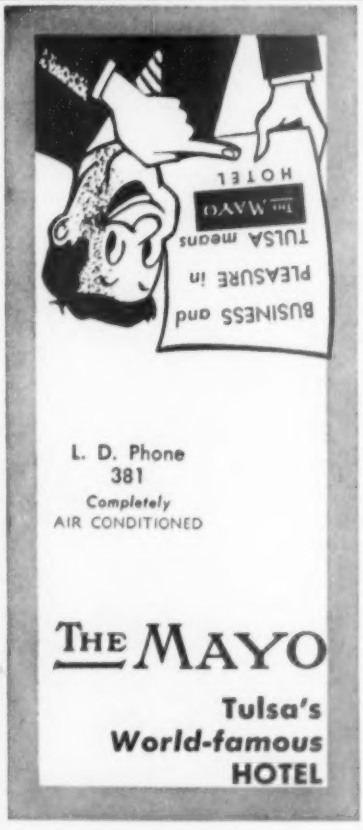



6-2n-1e, is about 8 miles northeast of Woodville, in the southeastern part of the county. It is 1½ miles southeast of Saukum field.

**Miller Brothers & Bowling,** Alice, Tex., have a rig running for Southern Minerals Corp. in the Alkek area, 2 miles southwest of Fannin, in Goliad County, South Texas. It currently is on Southern Minerals' 3 Swickheimer, in the Jessie Harris Survey.

**Ussery Drilling Co.** is drilling for Melba Production Co. at a wildcat location, 1 Pugh, in the James McGloin Survey, 12 miles southeast of George West, in Live Oak County, South Texas. Drilling is set up to go to 5,500 ft.

**Gilmour Drilling Co.,** Alice, Tex., has a contract operation scheduled for H. C. Hargrave and W. E. Colson, of Corpus Christi. It will be a 6,000-ft. test. Location is 2 miles southwest of Benavides, in Duval County, Southwest Texas. Designation is 1 Rossi, in Sweden Farm Lots, Section 12.

**Eagle Drilling & Development Co.,** Natchez, Miss., is drilling for Calto Oil Co. and Sunnyland Contracting Co. on a new well in Mud Creek field, in northeastern Wilkinson County, southwestern Mississippi. It is a 7,250-ft. job at 1-E Crosby, in 13-3n-1w.

**Como Drilling Co.,** Lafayette, La., is getting started on a Lower Cretaceous wildcat test 5 miles southwest of McCullough, in western Escambia County, southern Alabama. It is a contract job for M. B. Rudman and associates, of Dallas, and C. Dale Armour, of Pensacola, Fla. Location, at 1 Algier-Sullivan, in 18-2n-5e, is near the Baldwin County line, about 25 miles northwest of Pollard field, and about 30 miles east of Citronelle field, Mobile County. Contract is for 7,000 ft.

**Delta Drilling Co.,** Tyler, Tex., has a new deep contract job in Wood County, East Texas. It is a 9,500-ft. Woodbine test for Trice Production Co., of Longview, Tex. Location, at 1 Dohr, in the A. Yarbrough Survey, is 2½ miles northwest of Haynesville.

**Montgomery Drilling Co.,** El Dorado, Ark., is contractor on a 7,450-ft. Smackover test McAlester Fuel Co., of Magnolia, Ark., is starting at a wildcat location just west of El Dorado's municipal airport, in eastern Union County, southern Arkansas. The test, designated as 1 Deltic, spotted in 23-17s-17w, is more than 3 miles northeast of nearest Smackover production, in Cairo field.

Dowell service engineer controls each step in deepening drainage channels with Channeling Acid treatment.

# Operation for leveling decline curves

**Channeling Acid** has proved its effectiveness in smoothing out production decline curves—treatment after treatment.

For example, a well originally completed in a dolomitic limestone formation in 1939 was given a standard acid treatment in 1950. Tests indicated 15 BOPD pumping. In 1952 Dowell engineers recommended Channeling Acid to increase production. The treatment consisted of 1500 gallons of Channeling Acid followed by 10,000 gallons of silicate control acid. Production increased to test 114 BOPD pumping. *More than three years later the well is still an excellent producer, pumping its allowable of 38* BOPD.

Channeling Acid is an exclusive Dowell treatment that creates new passages for oil trapped deep in formations. Chemical agents make this possible by temporarily sealing off most of the pore spaces, allowing the acid to direct its attack on certain pores and form long drainage channels. The film-forming agents then break down and flow freely to the well bore.

For more information or service, call any of the 165 Dowell offices in the United States and Canada; in Venezuela, contact United Oilwell Service. Or write to Dowell Incorporated, Tulsa 1, Oklahoma, Dept. E-11.

***services for the oil industry***

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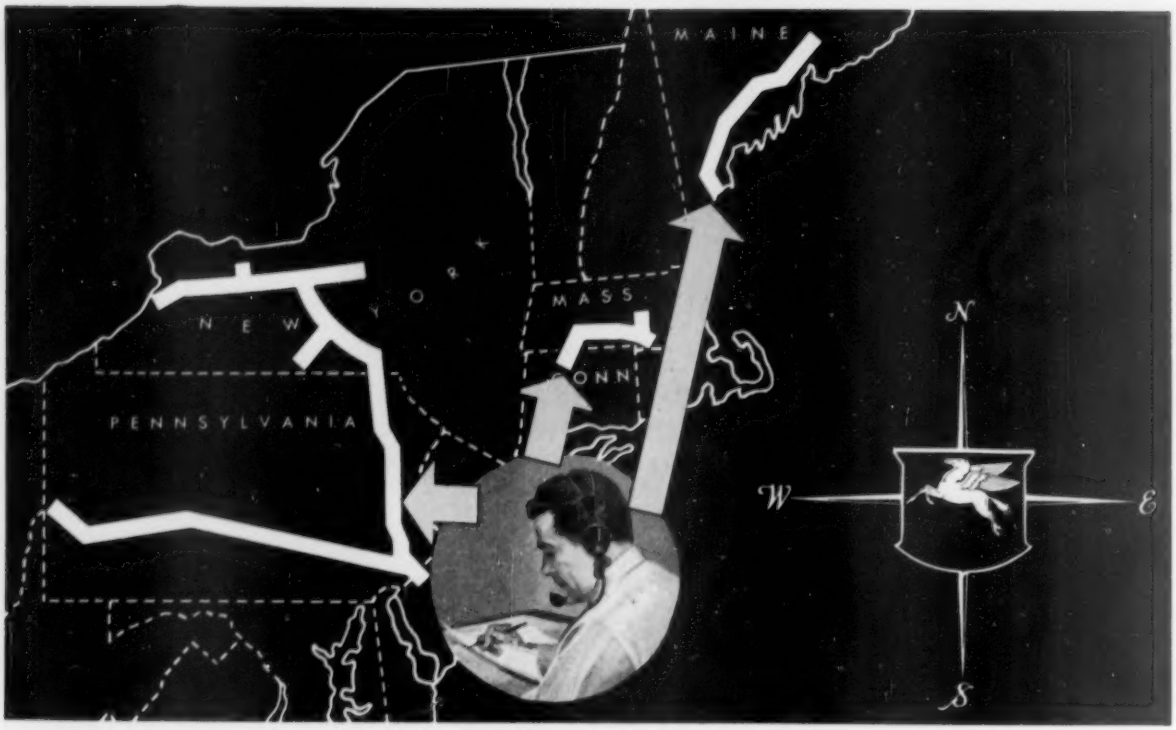



*The dispatcher receives hourly reports on pressure, temperature, gravity, and rate-of-flow from each station on three pipe lines.*

**SOCONY MOBIL OIL COMPANY, INC., REPORTS:**

# One dispatcher controls three eastern pipe lines with Bell System private line telephone service

## 24 YEARS OF SATISFACTORY SERVICE

One dispatcher—in Plainfield, N. J. —controls 1077 miles of Socony Mobil pipe line in seven states, as shown on the map above.

He uses Bell System private line telephone service to get hourly reports on pressure, temperature, gravity, rate-of-flow and other operating information from as many as 60 points along the system.

Over the same facilities, he issues orders to cut in additional pumps or cut them off, run gasoline and distillates into tanks, or put products into the line from refineries.

Socony Mobil started using Bell System private line communications 24 years ago, and the company's growth has been accompanied by a corresponding growth in its communication system.

The Bell System can supply services to fit *your* exact communication needs, too. Just call your Bell Telephone representative for further information.

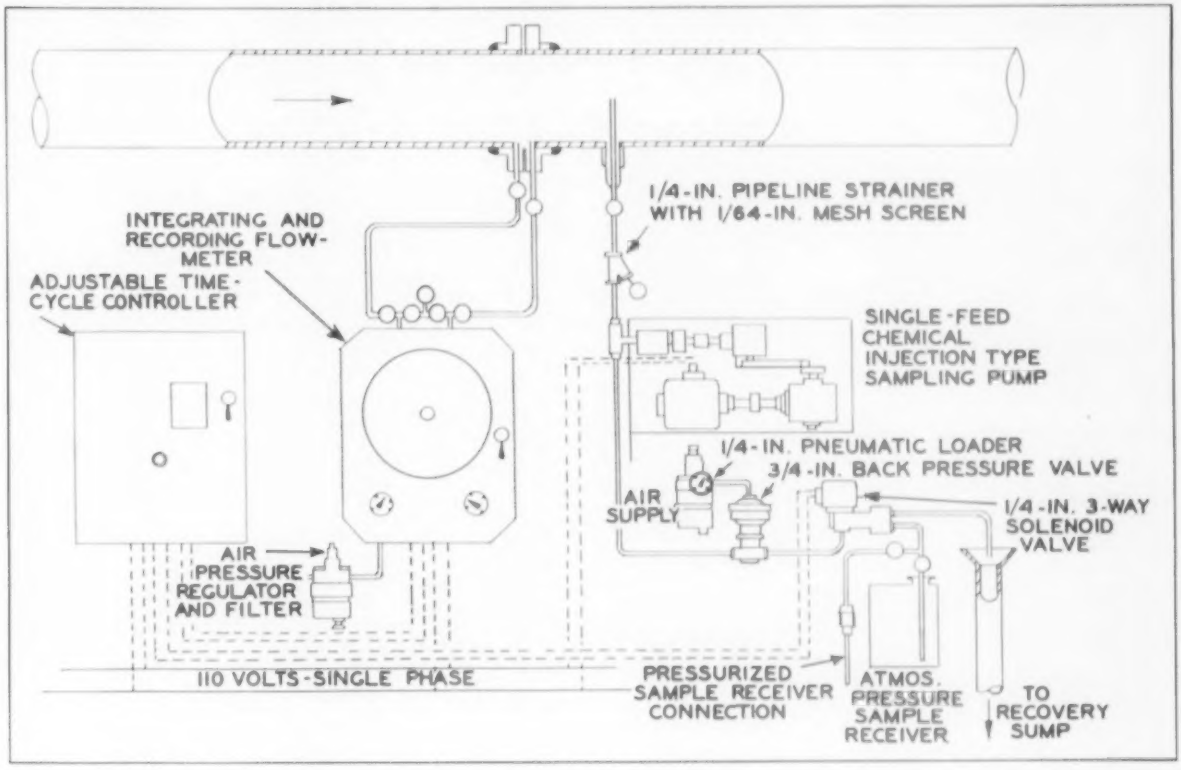
**Socony Mobil uses these Bell System private line services:**

Private line telephone service for pipe line dispatching and general administration.

Private line teletypewriter service for fast written communication between New York headquarters and the Paulsboro, N. J., refinery.

BELL TELEPHONE SYSTEM

TELEPHONE TELETYPEWRITER TELEMETERING AND REMOTE CONTROL CHANNELS




**FLOW is measured and integrated by orifice meter which sets time cycle controller. This, in turn, sets rate of sampling of pump assembly.**

*Here's Creole's way of taking . . .*

# Continuous and proportional samples

**by John H. Dinda* and Sinclair Spence†**

THE proportional and continuous pipeline sampler accomplishes two aims:

- To furnish a referee sample for analysis in overages and shortages in pipeline accounting. By this method, the qualities revealed by the sample are compared with those of the tank sample at the delivering and receiving terminals of the pipeline.
- To furnish a referee sample for comparison between shore-tank samples and ship-composite sample when making export shipments.

In addition, it is used to confirm the b.s. and w. content and so establish beyond doubt the amount of impurities delivered. This is of special importance because it confirms the accuracy of the involved quantities and qualities.

Bottom water and other impurities missed in the tank sample are detected and evaluated from the pipeline sampler.

Authors are with *Creole Petroleum Corp., and †Taylor Instrument Co., Caracas, Venezuela.

**Sampling method** . . . Sample withdrawal on a flow-rate-times-time basis is known as proportional sampling. It can be accomplished in various ways. For example, ratio flow control can be used to make the flow to the sample accumulator always proportional to pipeline flow. A second method is to withdraw a sample flow at constant rate and vary the time of withdrawal as a function of main-line flow. A third method is to withdraw a sample at constant flow rate for a fixed amount of time and vary the frequency of with-

**TABLE 1—SAMPLING TESTS IN THE DISPATCHING TERMINAL, DECEMBER 1951**

| Date— | Spot samples at 2-ft. intervals prior to pumping | Hourly spot samples at fixed level | Samples from pump disch.,* composite | Automatic pipeline sample | Conventional A.P.I. running samples | Remarks |
|---|---|---|---|---|---|---|
| December 7, 1951 | | 2.9 | 2.6 | 3.0 | 2.8 | "Fixed level"—4 ft. off bottom |
| December 11, 1951 | 3.1 | 3.0 | 3.1 | | | "Fixed level"—5 ft. 9 in. off bottom |

*Equal volumes of drip samples per hour.

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Other terminals for teletype, voice-plus-control & data transmission are available.

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# PIPELINE PATROL

drawal intervals as a function of main-pipeline flow.

As a matter of convenience, sample quantities were to be held to as small a quantity as possible without sacrifice of accuracy. This requirement caused the first method to be dropped, since a small orifice would have a tendency to become plugged by solids in the crude oil. The second method was rejected because of excessive complications. The third method was adopted because it needs no small orifice, is simple to understand, and is relatively free of maintenance requirements.

**Equipment description . . .** Fig. 1 shows a schematic arrangement of the proportional sampler as employed by a large South American oil company. An orifice-type meter measures and totalizes main pipeline flow. The totalizer is equipped with a device which transmits an electrical impulse upon the passage of a specified quantity of main-line fluid. This impulse initiates a time-cycle controller which in turn closes an electric circuit to a three-way valve for a time interval adjustable within the time-cycle controller.

The sample fluid is taken from a point downstream of the orifice (or any other point of high turbulence) in order to obtain a sample which is completely representative of the fluid passing through the line at any moment. It flows through a strainer and is picked up by a variable-stroke, low-volume metering pump. The outflow from this pump sends the sample through the three-way valve either to a sump or to the sample receiver, as determined by the time-cycle controller.

A pressure-relief valve is included in the pump discharge line to prevent free flow of oil through the pump due to line pressure. If this wasn't done, it could result in a large-volume sample which would neither be representative nor proportional.

**Flow meter . . .** This unit is so designed that for a predetermined flow of crude, the totalizer initiates a momentary air-pressure change which trips an electrical switch. This electrical impulse initiates the timing period of the FLEX-O-TIMER. Consequently, this electrical impulse is constant for throughput volume.

The timing period is adjustable so that the quantity of fluid per impulse sent to the sample receiver can be easily varied. Furthermore, the stroke in the low-volume metering pump can be adjusted so as to regulate sample flow. From this, a relatively wide range of ratio of sample to main-line flow can be obtained.

The integrator, timer, and metering pump are all powered from the same electrical source. Therefore, proportional sampling is unaffected by electrical frequency variations.

**Easily secured and installed . . .** All of the items incorporated in construction of the sampler, as indicated on the schematic drawing (Fig. 1), are standard products of the various manufacturers. They are available in packaged form or can be purchased separately and assembled on site. Obviously, the components of the system must be the best obtainable to meet the exacting requirements of securing uniformly representative samples with a minimum amount of maintenance.

### Performance

Two of the above samplers have been installed in our company's operations to date. The first unit was installed in the latter part of 1951 at one of the company's field dispatching terminals, and been in continuous service ever since. The second unit was recently installed at a marine loading terminal, but to date no information is available regarding the performance of this unit. This report, therefore,

**TABLE 2—WATER CONTENTS OF SAMPLES DRAWN AT HIGH GAGE FROM THE DISPATCHING TERMINAL (APRIL 15-MAY 15, 1952)**

| | Per cent b.s. and w. | | | |
|---|---|---|---|---|
| | A.P.I. three-spot sample | Drip sample pump discharge | Automatic sample P.P. No. 1 | Pipeline sampler, sample P.P. No. 2 |
| Arithm. average | 3.16 | 3.01 | 3.17 | 3.12 |
| Weighted average | 3.13 | 2.98 | 3.13 | 3.01 |

**TABLE 3—CRUDE-OIL MOVEMENTS (APRIL 15-MAY 15, 1952)**

| | Pumped by | | | Received by | |
|---|---|---|---|---|---|
| | A.P.I. 3 spot samples | Automatic P.L. samples | Drip* samples | A.P.I. spot samples | Drip* samples |
| Gross barrels at 60° F. | | 2,234,347 | | 2,232,611 | |
| Water in suspension, bbl. | 66,583 | 67,583 | 66,673 | 66,672 | 65,400 |
| Water in suspension, per cent | 2.96 | 3.02 | 2.98 | 3.08 | 2.93 |
| Net volume | 2,168,121 | 2,166,764 | 2,167,674 | 2,165,939 | 2,167,211 |

*Equal volumes of drip sample per hour.

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applies only to the unit installed at the dispatching terminal.

No special difficulties were experienced when the sampler was installed and placed in service. Interruptions have occurred only once or twice a year. Observed causes of these interruptions include plugging of the sampling line, wear of a minor part of the electrical switch, temporary lack of air, and occasional maladjustment of the relief valve.

The sampler is equipped with a double-plunger chemical pump, although normally a single-plunger pump is enough for routine sampling. This permitted a second sample being taken to double-check the results obtained from the sample point downstream of the orifice plate. The second sample was withdrawn from a point where the pump-station discharge header ties into the main line. This was considered to be the point of greatest turbulance in the entire system.

The same integrator, timer, and pump were used for withdrawing both samples and the rest of the equipment was duplicated. Both samples were caught in separate containers and were used as check samples against each other. They were also compared with tank samples taken at the dispatching and receiving terminals. The results obtained indicated that either of the two points can be used satisfactorily.

No direct attempts have been made to check the accuracy and reliability of the sampler, but intense study of sampling procedure and crude-oil movements have resulted in valuable information being gathered on its performance.

**Two test programs . . .** Two series of tests were conducted. The first series was designed to determine the correct sample-drawing method for the particular oil being handled. The second series was designed to establish that the sampling method selected was practical and gave exact results.

Crude-oil characteristics at the time of these experiments were:

Gravity: about 16.8° A.P.I.

Suspended b.s. and w. content: 2-3 per cent.

Viscosity at 100° F., about 500 S.U.s.

Daily pumping rate: about 70,000 bbl.

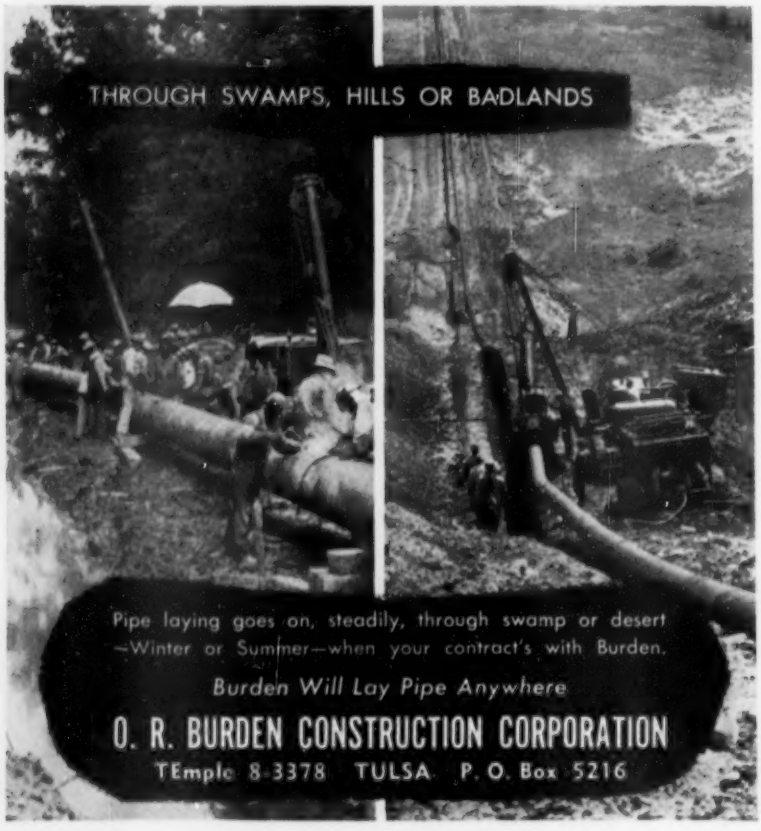
Tank sampling originally was in accordance with the A.P.I. running-sample method. It was noted, however, that the suspended b.s. and w. shown at the dispatching terminal was considerably and consistently lower than that shown at the receiving terminal—either by the same or other tank-sampling methods.

It was also observed that the suspended b.s. and w. content shown by the automatic sampler checked closely with the total suspended b.s. and w. shown at the receiving terminal.

**Results . . .** Table 1 shows results obtained from the first series of tests. It revealed that the A.P.I. running samples were not indicating the true suspended b.s. and w. content, and confirmed that spot samples and automatic pipeline samples—showing higher suspended-water content—approximated more closely the total water shown at the receiving terminal. On this basis, it was concluded that spot sampling gave more satisfactory results than running samples, and the A.P.I. three-spot sampling method was adopted.

In order to establish what accuracy could be expected from the A.P.I. three-spot sampling method, a second series of tests were conducted over a month period. During this period all gaging, temperature-measurement, and conventional sampling were duplicated by various sampling methods at several points along the entire stream. The results of these investigations, as they pertain to the subject, are summed up in Tables 2 and 3.

The above tests clearly indicated that properly drawn, hourly spot samples, A.P.I. three-spot samples, proportional drip samples, and proportional automatic pipeline samples gave suspended b.s. and w. contents which were comparable. They also revealed that spot samples and automatic pipeline samples gave essentially identical results. The water balances indicated in Table 3 show close agreement and confirm the accuracy and satisfactory performance of the automatic pipeline sampler.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## BOOK

GLOSSARY OF SELECTED GEOLOGIC TERMS. By William Lee Stokes and David J. Varnes. Published by Colorado Scientific Society, Denver Public Library, Denver, 165 pp. Paper bound, $2.75; cloth bound, $3.50.

This glossary is intended primarily for the civil engineers and specialists in related fields. It provides the reader with a compact glossary of terms found in the speech and writings of geologists and is a technical rather than a popular glossary. Scientific and technical terminologies are used where necessary, but the definitions avoid the jargon of science if at all possible.

The glossary contains about 2,670 entries; only the most general terms in mineralogy and paleontology are included. The definitions have been composed or selected after careful review of source material believed to be representative of recent literature.

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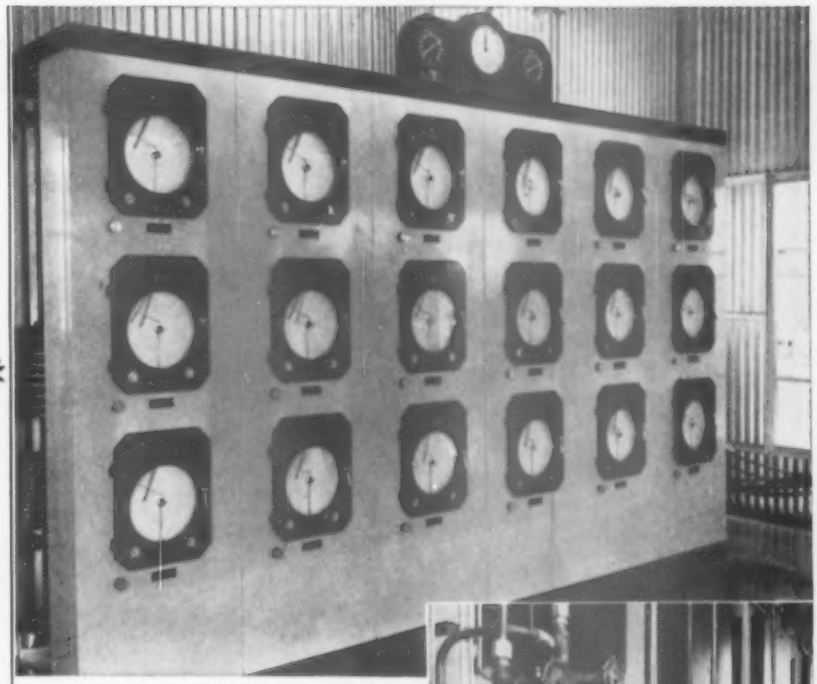

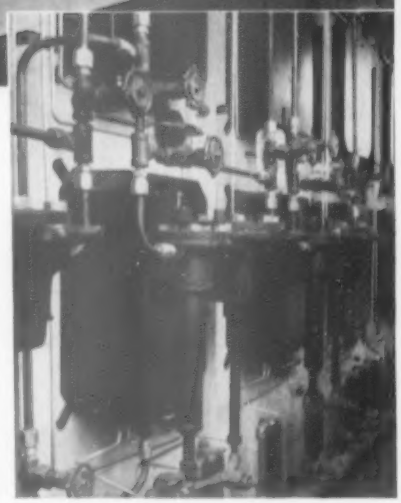

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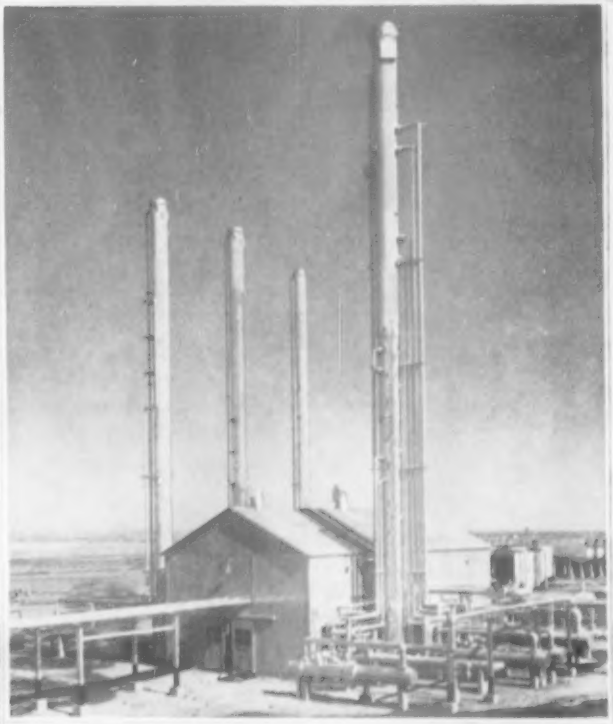

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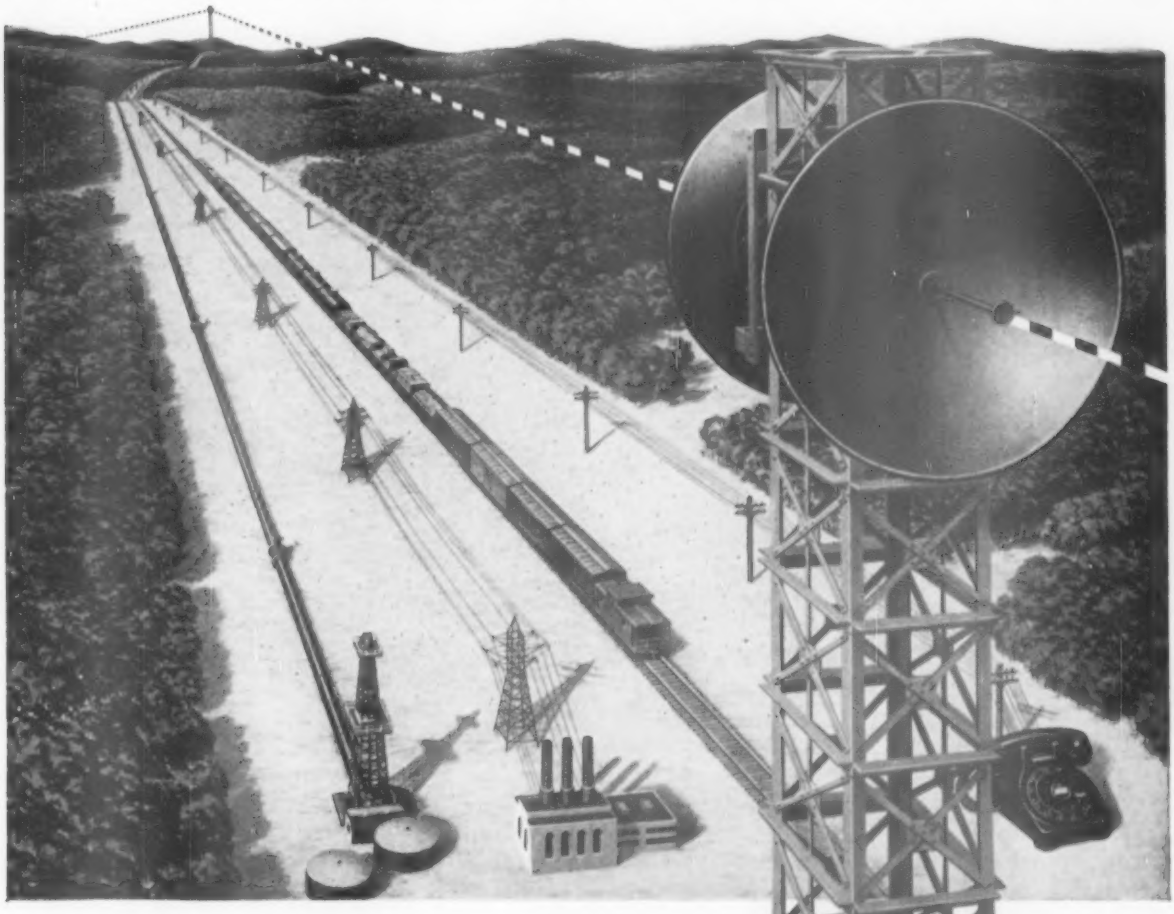

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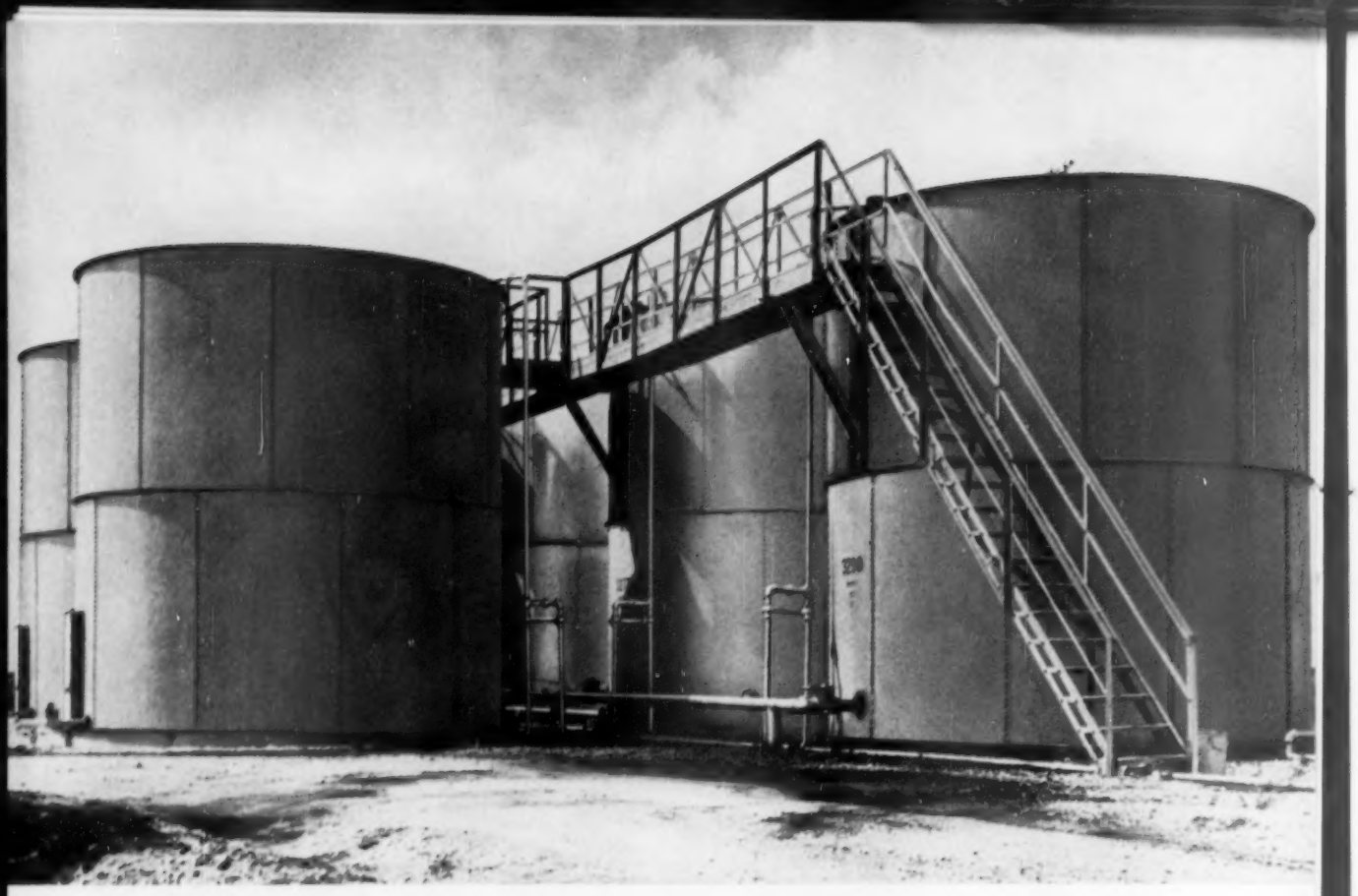

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# EQUIPMENT MEN . . . in the News

## Halliburton Elects R. G. Kelly a Director

R. G. KELLY

R. G. Kelly, vice president in charge of field operations for Halliburton Oil Well Cementing Co., has been elected a director of the company. He fills the vacancy created by the resignation of Sam M. Gladney, of Dallas, Tex., manager of Sun Oil Co.'s Dallas division, who had been a Halliburton director for 8 years.

A statement by L. D. Campbell, vice chairman of the company, and L. B. Meaders, president, said, "The board welcomes R. G. Kelly's 26 years of Halliburton experience and feels that the entire company will benefit by having a director who is so closely associated with our actual field operations."

The new director joined Halliburton Oil Well Cementing Co. in 1930 as driver of a cementing truck. He worked in Texas, New Mexico, and Louisiana oil areas until 1950, when he transferred to the Duncan, Okla., headquarters as a regional manager. One year later Kelly was named a vice president and in 1953 he became vice president in charge of field operations.

## Past Presidents Attend April Meet of L. A. Nomads

**Eight past presidents of the Los Angeles chapter of Nomads were present at the April meeting. Seven of them are shown with the present president. Standing: Henry Pullman of Baker Oil Tools, 1943; Bob Eiche, R. J. Eiche & Associates, 1947; Bill Wilson, Web Wilson Oil Tools, Inc., 1952; Joe Schlarb, Emsco Manufacturing Co., 1954. Seated: Ted Sutter, Baker Oil Tools, 1940; Elmer Decker, Martin-Decker Corp., first president, 1939; Harry Hester, McCullough Tool Co., present president; Ernie Fowks, Emsco Manufacturing Co., 1941. Not shown, Roland Smith, Roland Smith Co., 1944.**

## Axelson Managers Meet for Annual Conference

W. W. Greenway, general manager of Axelson Manufacturing Co., division of U. S. Industries, Inc., Los Angeles, was host to 23 Axelson managers at a 2-day sales conference held in Los Angeles recently.

Keynote of the meeting was "Getting Results." Edward D. Jackson, Axelson general sales manager, directed the meetings assisted by Ken S. Ramey, petroleum-equipment department sales manager; Jack Axelson, lathe-sales manager; Henry C. Miller, milling-machine sales manager; G. R. Shields, aviation sales manager; and J. W. Rockwell, hydraulic pumping unit sales manager.

Managers from the United States and Canada met with company executives directing all phases of Axelson operations, were briefed on new policies, taken on plant tours to see the enlarged manufacturing facilities at the Vernon and Montebello plants, and were brought up to date on new products and expansion of present lines.

## A. O. Smith's Tubular Products Names Managers

The appointment of Ben C. Heald and J. D. Kelly as district managers at Dallas, Tex., and New Orleans, La., has been made by A. O. Smith Corp., tubular-products division. The Dallas area includes the territory between Fort Worth, Dallas, Shreveport, northern Louisiana, and southern Arkansas. The New Orleans area will cover the coastal areas of Louisiana, Mississippi, and Alabama.

Both men also act as sales representatives for the process equipment of A. O. Smith.

## Scholarship Program Begun By Mission Manufacturing

A scholarship program was recently announced by W. B. Sharp, president and chairman of the board of Mission Manufacturing Co. At the beginning, Rice Institute, University of Texas, and Texas A. & M. will benefit with the scholarship grant expanding to four at each of those three schools. Sharp stated that the company hopes this program will help bring about a closer relationship between industry and universities.

Dr. William V. Houston, president of Rice Institute, introduced Hillary M. Norman, Jr., the scholarship winner from Rice Institute. Also present was

Dr. A. J. Chapman, head of Rice's mechanical-engineering department.

Dr. W. R. Woolrich, dean of the University of Texas school of engineering, introduced the university's scholarship winner, Eric Jones.

For Texas A. & M., whose scholarship candidate is still to be selected, Dr. John C. Calhoun, Jr., dean of engineering, and E. E. McQuillen, executive director of A. & M.'s development fund, were present.

Representing Mission Manufacturing, in addition to Sharp, were Richard White, executive vice president, and Bass Hoyler, personnel director.

## Dickenson Organizes Valve Distributing Firm

Organization of Valve Engineering & Supply Co., with offices and warehouse at Tulsa, has been announced by Glenn Dickenson, president.

The firm will act as a stock distributor for all types of valves used in oil field, pipeline, and refinery operations. The firm will handle cast steel gate valves of Kerotest Manufacturing Co., Pittsburgh, and iron and bronze valves of Fairbanks Co. of Binghamton, N. Y.

A supply of forged steel valves, fittings, and flanges as well as welding fittings will be stocked.

Dickenson served for the last 12 years as Mid-Continent representative of Kerotest.

## J&L Supply Appoints Judd, Clark in New Divisions

Rainey Elliott, president of Jones & Laughlin Supply Division, has announced two managerial appointments in newly created production and drilling-equipment divisions of the firm's sales operations.

W. R. CLARKE

JACK JUDD

William R. Clarke, formerly chief engineer, has been appointed manager of production-equipment sales; and Jack Judd, formerly rotary-machinery salesman, has been advanced to manager of drilling-equipment sales. These positions have been incorporated into the general products sales division.

Clarke has been with the firm since 1936 when it was known as Frick-Reid Supply Co. Judd joined J&L in 1952, after several years of sales experience in the oil-field-equipment business. He was associated with Hughes Tool Co. as a field representative, and later served as district sales manager for Orbit Valve Co.

## Baker Transfers, Appoints In Central Division Staff

Baker Oil Tools, Inc., Houston, recently announced personnel transfers and new appointments in the central division.

In the West Texas district, J. T. Mitchell, former branch manager at Odessa, has been appointed assistant district manager with headquarters in Odessa, and J. V. Bergman, branch manager at Farmington, N. M., will transfer to Midland, Tex., as district sales engineer.

L. Grubenman, former representative in Maracaibo, Venezuela, has been appointed branch manager at Shreveport, La. S. O. Timmons, Jr., former branch manager at Palestine, Tex., has


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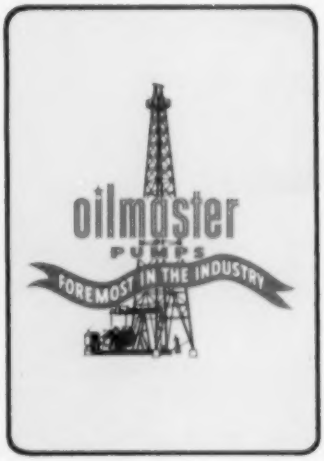


been transferred to Odessa as branch manager. E. M. Solter, formerly branch manager at El Dorado, Kans., has been transferred to Great Bend, Kans., as branch manager.

New appointments include: D. A. Moody, W. A. Shelton, C. M. Courtney, and Jack Hoffman as branch managers at Victoria, Tex., El Dorado, Palestine, and Snyder, Tex.

## Maloney-Crawford Appoints L. G. Rader, C. B. Warren

L. Glenn Rader has been appointed vice president and general manager of sales for Maloney-Crawford Tank & Manufacturing Co. of Tulsa, and C. B. (Clint) Warren has been elevated to the division managership at Houston, according to S. P. Wallace, president.

Rader, former division manager at Houston, will make his headquarters in Tulsa. He has had 30 years' experience in selling tanks, separators and treater equipment.

## Rowland, Dicus Appointed By Wilson Manufacturing

The appointment of Fred Rowland and Ralph J. Dicus as sales representatives for Wilson Manufacturing Co.,

FRED ROWLAND

R. J. DICUS

Inc., of Wichita Falls, Tex., has been announced by Aubrey A. Wilson, general sales manager of the company.

Rowland has been assigned to a new territory in East Texas and South Louisiana. He will specialize in barge jobs and deep-well workover units. Dicus will be working out of the Houston office, acting as general representative covering the field. Both Rowland and Dicus will spend considerable time on the Super line of Wilson rigs.

## Wagner-Morehouse Appoints Engineering-Sales Agent

C. F. (Chuck) Riker has been appointed engineering and sales representative for Wagner-Morehouse, Inc., of Los Angeles. This follows the recent appointment of Continental Supply Co. as the distributor for Wagner-Morehouse. Continental's sales territory for the Los Angeles company includes all of Canada and the United States with the exception of California, Oregon, and Washington.

Riker will headquarter in Dallas, Tex. The new representative formerly was a liaison engineer for Latin American, Inc., and was stationed in Mexico and Central and South America.

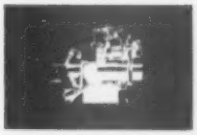
Wagner - Morehouse rigs and well-servicing units are all mounted on trucks, semitrailers, or are the self-propelled type. These units can be furnished complete with telescoping masts, draw works, power units, and accessory equipment in highly mobile packages.

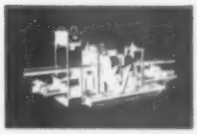
## Du Pont Names Petroleum Chemicals Managers

R. F. HARWICK

Managerial appointments have been made by du Pont Co.'s petroleum Chemicals Division, it has been announced by David H. Conklin, director of sales. Robert F. Harwick has been named manager of the western region. George L. Tyler becomes assistant manager,


REMCO PIPELINE EQUIPMENT





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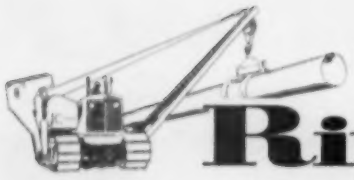

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ROBERT THOMAS
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and William B. Gest has been named manager of the newly created Cleveland, Ohio, district.

Edison D. Jeffus has been named to the newly created post of additives manager for the Gulf Coast region, headquartered in Houston. William W. Wingate has been appointed to the other new position of additives manager for the Mid-Continent region with the main office in Tulsa. Richard O. Braendle moves to assistant to the manager of additives sales in Wilmington, the post formerly held by Wingate.

William K. Park has been transferred from the central region to the eastern region as an account manager with headquarters in New York City.

## W-K-M Appoints Young Director of Engineering

H. BEN YOUNG

The appointment of H. Ben Young as director of engineering for W-K-M Manufacturing Co., Inc. has been announced by J. S. Downs, president. Young formerly was with Mission Manufacturing Co. where he served several years as chief engineer and for the past several years as director of overseas projects.

As director of engineering, Young fills a position recently created by the expanding research and development program W-K-M is undertaking as a result of its consolidation. He heads the engineering and research activities of all three product lines, W-K-M through-conduit gate valves, ACF lubricated plug valves and Key refinery fittings, alloy-steel welding fittings, and joint-sealing compounds.

W-K-M has recently completed its new 12-acre manufacturing plant and is now operating at full schedule. W-K-M is a subsidiary of ACF Industries, Inc.

## Macwhyte Co. Elects F. D. Holden, G. Johnston

At a meeting of the board of directors following the company's annual stockholders' meeting, Francis D. Holden was elected vice president in charge of sales for Macwhyte Co. Goodwin Johnston, formerly treasurer and assistant secretary, has been elected to the new office of secretary-treasurer. M. A. Buntrock, formerly secretary, has retired.

Holden has had 20 years' experience in Macwhyte Co.'s general sales and export division.

## Engineering Appointees Named By Unit Rig

Tom Moughon has been promoted to assistant chief engineer, and M. D. Lackey has been appointed development engineer for Unit Rig & Equipment Co., according to Ken Davis, Jr., president.

Prior to joining Unit Rig in 1946, Moughon had 10 years design experience with other manufacturers of oilfield equipment and was associated with Service Drilling Co. Prior to affiliation with Unit Rig in 1952, Lackey was with Westinghouse Electric Co. and also had 6 years' experience in design of oil-field equipment with a major equipment manufacturer.

## Kirk, Overly Head Newly Formed Macco Gas Lift Co.

Formation of Macco Gas Lift Co. in Odessa has been announced by Rufus Kirk and James A. Overly. The company was organized to handle sales and service of Macco gas-lift valves. Territory covered by the firm includes all of West Texas and New Mexico. Manu-


Another First for OILCO Repacking Speed

RIGHT NOW, WRITE for the two new six-page folders, descriptive of the new Oilco Spring-Matic loaders, No.'s 451, 451-M, 461 and 461-M, equipped with the No. 856 Swing Joint, which was created to simplify and to speed up the repacking operation.

The illustration demonstrates the process: Remove the flange bolts, roll out the flange assembly, replace the seal, restore the bolts, and the job is done in a twinkling.

This successful swing joint employs three ball bearings — two for the radial load and the third for the thrust load. Perfect alignment of these three bearings insures maximum packing life and smooth, easy vertical movement of the loader.

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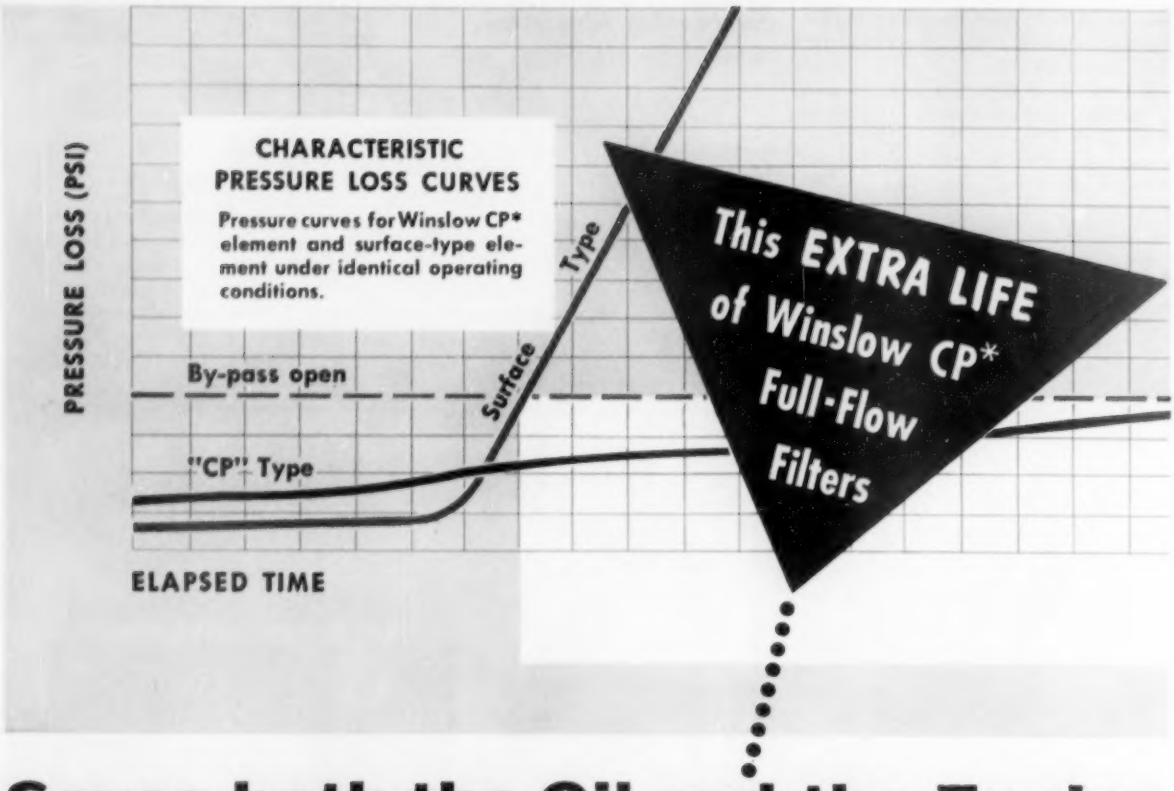
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PRESSURE LOSS CURVES
Pressure curves for Winslow CP* element and surface-type element under identical operating conditions.
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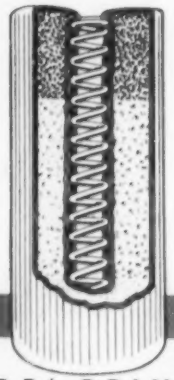
By-pass open
Surface Type
"CP" Type
ELAPSED TIME
This EXTRA LIFE of Winslow CP* Full-Flow Filters

# Saves both the Oil and the Engine

Laboratory tests and operating experience indicate that Winslow CP* filters have as much as 50% more useful life than a surface-type filter. As a result, both the lube oil and the engine are protected beyond normal filter service.

Contractors, for instance, report that useful oil life in diesel-powered equipment has been extended from 80 hours to 300 hours, with Winslow CP* filters.

Most important, engines are protected all the time with Winslow full-flow filtration . . . protected during cold starts, while idling and against excessive dirt . . . protected if a bearing fails. Because of this better oil filtration, engines last longer and require less maintenance. A modest investment in Winslow filters returns substantial dividends.



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**Winslow patented CP* (Controlled Pressure) elements are designed to continuously self-adjust the pressure within the filter and allow for a full stream of filtered oil from the filter without opening by-pass valves. This is accomplished through the dual flow capacity, with two types of material, as illustrated.**

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W-56-1

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facturer of the line is Macco Oil Tools, Inc. of Houston.

Kirk is a former president of MWL Tool & Supply Co. in Midland. Overly was formerly general manager of the same firm.

## Pritchard Appoints Sales Representative for Mexico

A. Gonzalez-Flores, Mexico City, Mexico, has been appointed sales representative for the Republic of Mexico by J. F. Pritchard & Co. of California, Kansas City, Mo. Gonzalez-Flores' experience includes working with Celanese Mexicana SA. He has been engaged in technical sales, development, and engineering since 1951 and manages Desarrollo Industrial.

## Disneyland's Visitors See Crane's Story of Oil

The Crane exhibit at Disneyland, Anaheim, Calif., was dedicated recently at ceremonies attended by Crane President Frank F. Elliott, Walt Disney, creator of Disneyland, and a group of industry and trade officials.

The exhibit features an industrial-valve display depicting the story of petroleum from oil well to market. Highlighting the display is a Crane 8-in. cast-iron conduit pipeline valve, cut away to show the closing mechanism.

Thousand of visitors to Disneyland will read that "Petroleum is the black gold that gave us freedom of movement. You will find Crane valves used in the production, transportation, refining, and marketing of oil and oil products."

## Procon, Inc. Organizes International Subsidiary

Procon, Inc., has announced the formation of a new subsidiary, Procon International, S.A., to handle its expanding petroleum-process construction activities outside the United States.

C. B. Whyte, president of Procon, Inc., also heads the international subsidiary. J. C. Reed and A. G. Petkus are vice presidents; J. E. Quinn, secretary; and A. J. Rohrman, treasurer.

While its operations are expected to be centered in South America, the new corporation's first major assignment is to construct all facilities for a 20,000-bbl. per day refinery in Cuba for The Texas Co. The firm will have headquarters in Chicago and a branch office at Santiago de Cuba.

## Oilwell Makes California And Eastern Appointments

The transfer of Norman E. Cordell, field representative for U. S. Steel's Oil Well Supply Division, from Clay City to Mattoon, Ill., and the appointment of Harold E. Reeves as manager of the Fairfield, Ill., store were announced by C. H. Maynard, eastern


More shut-offs per dollar!

Globe or gate, solder cup or threaded . . . you get extra value with NIBCO pressure rated valves. That's because their Nibcoloy stems permit the cutting of accurate long-wearing threads, are high in tensile strength, and are non-corrosive. Then, too, valve bodies are 85-5-5-5 alloy in accordance with A.S.A. standards. In fact, NIBCO valves meet or exceed all performance standards . . . with SWP and WOG pressures clearly marked on side of the body. And they're made by valve specialists — in a plant devoted exclusively to the manufacture of valves.

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★ SULFUR-FREE GAS

★ AT LOWEST COST

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Elizabeth, N. J.

area manager of the division. The transfer of Arne S. Johnson, district representative, from Bakersfield to Taft, Calif, was announced by D. S. Grubbs, California area manager of the division.

Cordell was employed by Oilwell at Fairfield in 1950, in 1952 transferred to Salem, and in 1953 was named field representative and transferred to Clay City. Reeves joined Oilwell in 1948, and in February 1956 he became field representative at Fairfield. Johnson was employed in 1950 at Oilwell's Avenal, Calif., store. In 1951 he became field representative at Bakersfield, and in 1955 he was appointed district representative at Bakersfield.

## Fanshier Is Corrosion Rectifying Representative

Harvey Fanshier, corrosion engineer, has been appointed midwestern representative for Corrosion Rectifying Co. of Houston, it has been announced by Wayne A. Johnson, company president.

Fanshier was previously employed in the logging department of Lane-Wells Co. and as a petroleum engineer for Petroleum, Inc., where he had specialized in salt-water-disposal engineering and corrosion engineering. Fanshier will make his headquarters at Great Bend, Kans.

## Offshore Exploration Group Moves Houston Staff

Offshore Exploration Group has moved to new quarters in Houston where the firm will be centrally located with all divisions concentrated in one building. The announcement was made by E. R. Locke, president. Management, research, and maintenance facilities for reproducing Reynolds sections and blueprints are concentrated at the new location.

The company expects its service will be faster as a result of the increased facilities and space.

## Security Names Appointees In Expanded Sales Dept.

Major expansion in the sales department of Security Engineering Division, one of the Dresser Industries, is continuing, according to A. M. Birnie, vice president in charge of sales for the oil-tool-manufacturing company. E. L. McElwain has been named assistant division sales manager for the Rocky Mountain division; Kenneth Ray Grumbles has been promoted from sales engineer to district sales manager for the California district.

E. L. McELWAIN

DAN MOLLOY

A new branch office to furnish the Mississippi River area with Security equipment and materials has been opened in Venice, La., with Dan Molloy named manager of the branch, according to L. M. Bracewell, Louisiana division manager. Two additional field representatives for the Texas Gulf

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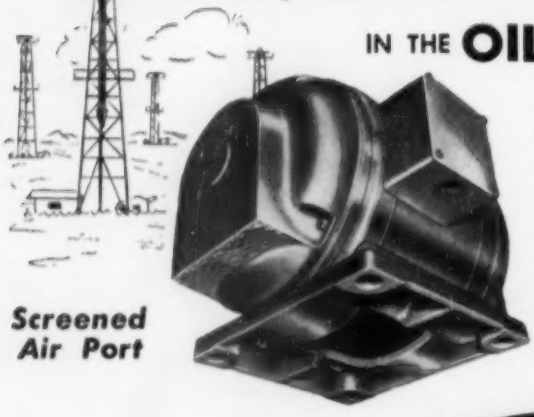

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Peerless Supply Co., Inc.

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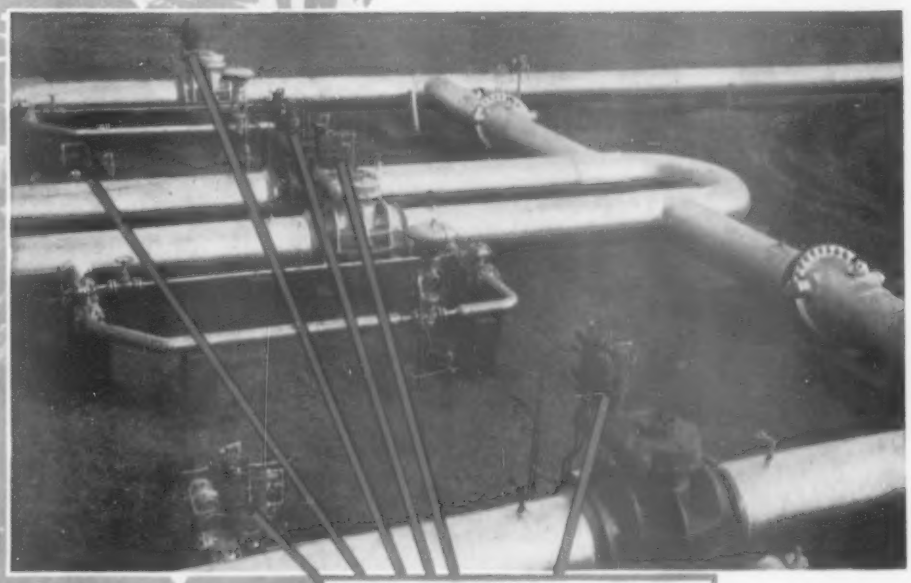
Shreveport, La.

# THE E.I.M. FIREMEN



All E.I.M. Installations of This Type Conform With "Emergency Shutdown Facilities" (No. B43.431 Section 8, ASA B31.18-1955)

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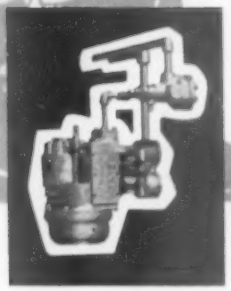

EIM G-2 valve controls guide the flow of gas through compressers where the pressure is increased.

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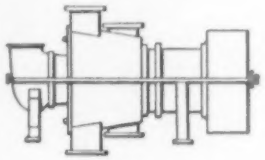
The mechanical simplicity and conservative design of Westinghouse turbines give you the reliability you expect and want in pipeline service. • The complete absence of sliding motion reduces friction and wear to an absolute minimum. • There is no cooling water system required. • Permanent alignment is assured by turbine's rigid construction — no bedplate is needed. • The highly precise hydraulic governing system has been proved on millions of horsepower of steam turbines.

For more information, see your Westinghouse sales engineer, or write for booklet DB-1515 to Westinghouse Electric Corporation, 3 Gateway Center, Pittsburgh 30, Pa. J-50590



***WATCH WESTINGHOUSE!***

*WHERE **BIG** THINGS ARE HAPPENING FOR **YOU!***

5000-hp gas turbine with cover removed.

area, L. A. Simpson and J. W. Duran, have been appointed.

McElwain joined Security in 1948, served as sales engineer at Casper, Wyo., and district manager in West Texas and Hobbs, N. M. He has had 22 years' experience in the drilling industry. Grumbles has been with Security 2 years. Molloy has had drilling experience in South Texas, Venezuela, and southern Louisiana.

Simpson will headquarter at Liberty, Tex., and Duran will represent Security in the Corpus Christi area.

## Shannon Heads McCarty's Petroleum Advertising

P. SHANNON

A department specializing in petroleum - industry advertising and public - relations service has just been established by The McCarty Co. of Texas, Inc. Pierce Shannon, account executive, will be in charge of the department, it has been announced by Russ Jurgens, the agency's vice president.

Shannon has had experience in all phases of publishing, advertising, and public relations and has extensive knowledge of the petroleum industry.

## Flaherty and McGivern Appointed by Polyken

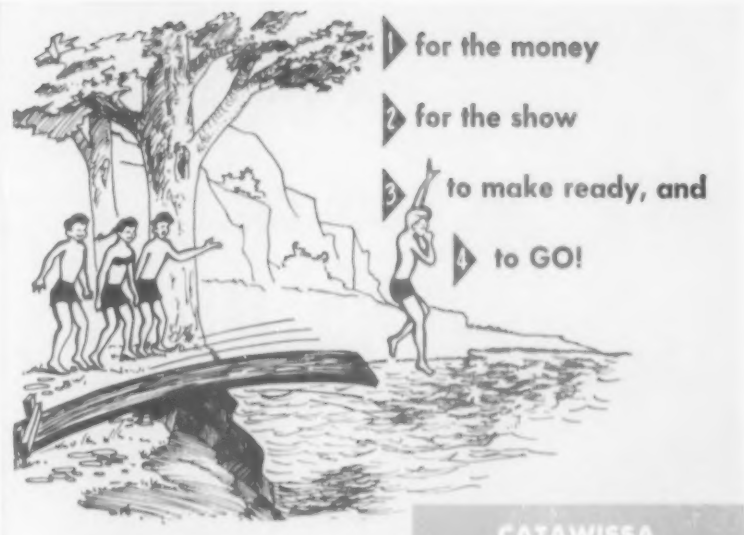
The Polyken Sales Division of The Kendall Co. has announced new appointments in its protective - coating marketing program. William J. Flaherty and John M. McGivern have been assigned as market-development specialists in the merchandise department working directly with Howard D. Segool, merchandise manager, Chicago.

Flaherty, who was formerly eastern field sales engineer for Polyken protective tape coating, will continue to work out of Philadelphia. McGivern, until recently associated with The Oil and Gas Journal, will headquarter in Tulsa.

## Emsco and SN.MAREP Sign License Agreement

William T. Powell, president of Emsco Manufacturing Co., announces the licensing for the manufacture and sale in France and French territories of Emsco oil-well drilling rigs and engine transmissions by Societe Nationale de Materiel pour la Recherche et l'Exploitation du Petrole.

Powell and D. M. Bailey, vice presi-

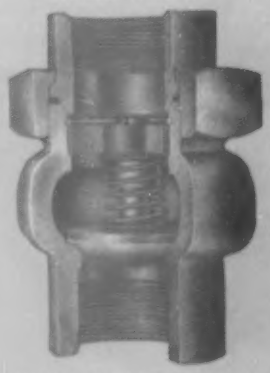

1 **Compare the price tag**
of a Catawissa 400-M Spring Controlled Check Valve against any check valve of its kind on the market!

2 **Consider the appearance**
of Catawissa 400-M Check Valves. Precision machining of contour steel castings and forgings makes the big difference!

3 **Ease and speed of application**
make Catawissa 400-M Check Valves ideal for jobs where valuable space is wasted on the full union and nipple necessary to install the conventional type check valve!

4 **Observe the heavy wall sections**
of the nickel semi-steel body and forged steel coupling nut, where strength counts!

CATAWISSA
400-M
SPRING CONTROLLED CHECK VALVE



THE CHECK VALVE WITH THE PERFECT SEAL UNION CONNECTION

Gives Positive Seating, Eliminates Vibration or Hammering
in vertical or horizontal use

☆

All Applications
including mild, common acids; non-oxidizing alkalies; hydro-carbons and ammonia.

☆

Sizes 1" thru 3"

You can forget your check valve problems when you install Catawissa 400-M Spring Controlled Check Valves! They're built to last indefinitely with Catawissa's exclusive 3-to-1 Safety Factor, the extra value feature of all Catawissa products . . . your assurance of trouble-free service.

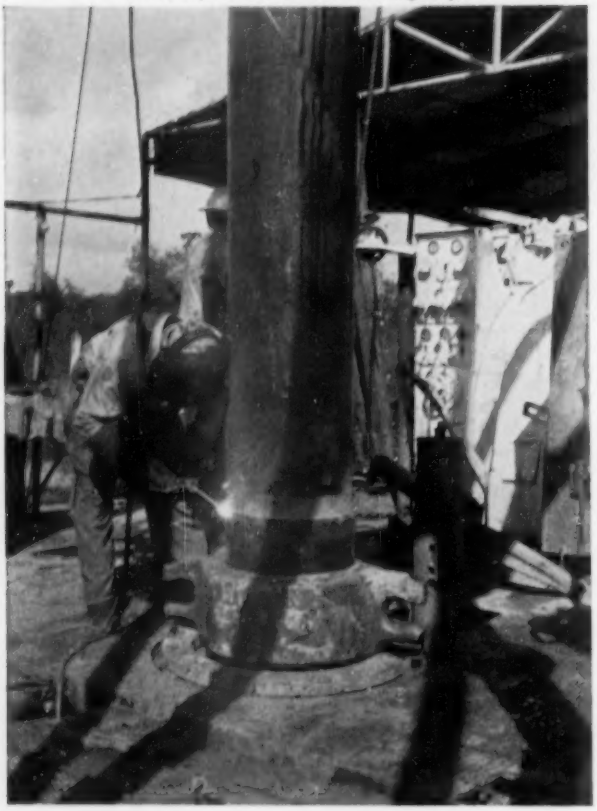
These valves are more easily accessible than any other type spring controlled check valve on the market. The single union connection may be broken and working parts removed for repairs or inspection without removing the valve from the line.

• AT YOUR FAVORITE SUPPLY STORE •
CATAWISSA VALVE AND FITTINGS COMPANY
CATAWISSA, PENNA.

# THIS COLLAR

## Helps you get Armco Casing down the hole...FAST

Armco Slip-Joint collar makes welding easy.



The Armco Slip-Joint Collar speeds running time. Just stab the end of the next joint into the collar, make a quick weld and the string is ready to lower.

Line-up and stabbing are fast and easy with the uniformly round diameter and square cut ends of Armco Casing. And there are no threads to cut into the casing wall.

Armco Casing offers you many other advantages: You can select the exact size you need from the wide range of diameters (6 to 24 inches) and wall thicknesses ($\frac{3}{16}$ to $\frac{1}{2}$ inch) available in Armco Casing. Long, 40-foot lengths mean fewer joints to handle and weld.

Armco Slip-Joint Casing is distributed by National Tank Company from 25 stocking points conveniently located throughout the oil country. Chances are one of these stocking points is near you.

Write to us for more data. Armco Drainage & Metal Products, Inc., Welded Pipe Sales Division, 5066 Curtis Street, Middletown, Ohio. 201 KOME Building, Tulsa, Oklahoma. Subsidiary of Armco Steel Corporation. Export: The Armco International Corporation.

# Armco Slip-Joint Casing

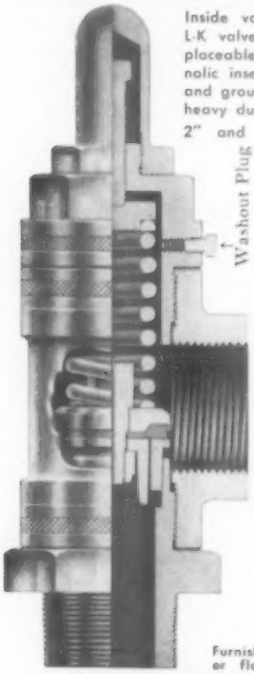
**Distributed by National Tank Company, Tulsa, Oklahoma. In Canada: National Tank Company, Ltd., Edmonton, Alberta**

**National Tank Company Stocking Points for Armco Casing.** Swift Current, Canada; Williston, North Dakota; Casper, Wyoming; Brush, Colorado; Sidney, Nebraska; Great Bend, Kansas; Liberal, Kansas; Oklahoma City, Oklahoma; Seminole, Oklahoma; Pawhuska, Oklahoma; Hobbs, New Mexico; Pampa, Texas; Lubbock, Texas; Snyder, Texas; Abilene, Texas; Electra, Texas; Odessa, Texas; Corpus Christi, Texas; Houston, Texas; Shreveport, Louisiana; Lake Charles, Louisiana; New Iberia, Louisiana; Harvey, Louisiana; Clay City, Illinois; New Harmony, Indiana.

ARMCO®

**L-K RELIEF VALVE**

**Positive • Simple • Economical**




Inside valve uses regular L-K valve design with replaceable laminated phenolic insert and hardened and ground steel seat and heavy duty steel body.

2" and 2½" carried in stock. Other sizes can be furnished quickly on receipt of order. Laminated phenolic valve insert will not "freeze" on hardened steel valve seat.

For extremely high pressures, L-K Relief Valves are of similar design, but of heavier construction and slightly different arrangement of interior. For gas, air or vapors, L-K Relief Valves are of similar design, but with special ball insert.

Furnished with screwed or flanged connections.

"Ask Your Supply Company About It"
WRITE US TODAY FOR FULL INFORMATION

**L-K PUMP VALVE CO.**

P. O. Box 901 Houston, Texas

**HILLER LEADERSHIP**

...results from constant research

in cooperation with the Army, Navy, and Air Force

*Engineers:* write for opportunities with an industry leader in an ideal California locale.

**HILLER HELICOPTERS**

PALO ALTO, CALIFORNIA


dent and general counsel of Continental Supply Co., world distributors for Emsco, signed the license agreement with F. Emmanuelli, president and general manager of SN.MAREP.

SN.MAREP manufactures and distributes equipment and drilling materials for the European market, and this arrangement will substantially increase the manufacturing range of materials necessary in the search for oil. Emsco will furnish technical assistance necessary to the engineering of equipment fabrication.

## Stewart & Stevenson Names Odessa Operations Manager

D. D. KLAGER

David D. Klager has been appointed operations manager of the Odessa branch of Stewart & Stevenson Services, Joe Manning, vice president and general manager, has announced. Klager joined Stewart & Stevenson in 1951.

## Koch Appoints Fisher As Illinois Representative

In line with the company's expanded Flexitray program, M. B. Fisher has been appointed sales representative for the State of Illinois and Lake County, Indiana, for Koch Engineering Co., Inc., Wichita, Kans. Fisher, who will make his headquarters at Park Ridge, Ill., has had experience in refineries and plants in the Mid-West and Southwest. He was formerly with Leeds Northrup Co. and Universal Oil Products Co.

## Two Texas Companies Merge Into Standard-Southern

Standard Pipe Supply Co. of Houston has announced the acquisition of certain assets of Southern Oilfield Material Co. of Beaumont, Dallas, and Odessa, Tex.

Gerald Rauch, president of Standard Pipe Supply Co., and Walter Monroe, Jr., president of Southern Oilfield Material Co., issued a joint statement in which they said that the combined operations of both companies would be under the new name of Standard-Southern Corp.

Morris Rauch is founder and chairman of the board of directors of Standard Pipe Supply Co. Gerald Rauch, president of Standard - Southern, announced the election of Walter Monroe, Jr., as vice president and the appointment of Thomas F. Hughes as manager of the Beaumont branch and


Your fuels and lubricants will meet exacting operational standards when you specify

**ENJAY PETROLEUM ADDITIVES**

including

**ENJAY PARANOX®**

detergent-inhibitor additives

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Your only source for a complete line of diversified, high quality petroleum additives (Paramins®).

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*Pioneer in Petrochemicals*

THIS IS THE STORY of three men and a VALVE. Joe, a chemical engineer, needed valves that could handle tough corrosives. Bill, a refining engineer was looking for valves that gave a positive shut-off. Tom, working for a large industrial firm, needed valves that sealed both upstream and downstream. All three solved their problems by specifying Hamer Visible Wedge Valves. These remarkable valves combine the double sealing action of precision metal-to-metal fit augmented by dependable seal rings.
The wedges are trimmed with nickel, while seats are trimmed with stainless steel to withstand the roughest corrosive conditions. The full-view wedges are handwheel operated --can't blow out or drop on a toe. The wedges pivot so no lifting is necessary.
So if your plans require long service, sure-seal shut-off valves, by all means specify
HAMER VISIBLE WEDGE VALVES.
P.S. For descriptive literature, write:

Hamer VALVES, INC.
2919 Gardenia Ave., Long Beach 6, California
Representatives Throughout the World.

J. Marion Hunter as manager of the Odessa branch.

Standard-Southern Corp. will have its main offices in Houston, a district sales office in Dallas, and warehouses in Beaumont, Houston, and Odessa.

## Wiegand Heads Perforation Work for Jet Research

J. H. WIEGAND

Dr. James H. Wiegand has been appointed vice president and technical director of Jet Research Center, Inc., Blake Caldwell, president of the newly formed research and manufacturing company has announced. Wiegand comes to Jet Research from a position as chairman, department of chemistry and chemical engineering, Southwest Research Institute. He will direct the research and development activities of Jet Research Center at Arlington, Tex., on improved shaped charges for oil-well perforation.

In addition to technical literature on gas absorption and unsteady state propulsion, Wiegand has made many contributions to the literature on propellants and explosives.

## BJ Service Promotes Lamkin to Station Supt.

The promotion of Howard N. Lamkin to station superintendent at Sterling, Colo., for BJ Service, Inc., has been announced by W. T. Box, vice president and manager of operations. Lamkin formerly was service supervisor at Worland, Wyo.

Lamkin began work with BJ Service in 1947 as an equipment operator and later served as a service engineer before becoming service supervisor at Worland.

## J. H. Abrams Heads New Central Territory for ACP

American Chemical Paint Co. has acquired office and plant facilities at St. Joseph, Mo., and expects to be operating there about June. Heading the branch will be J. H. Abrams, associated with American Chemical Paint Co. for many years in a supervisory capacity in its Pittsburgh territory. Technical representatives will provide technical servicing and consultation for ACP customers in the new territory.

The new ACP office and plant will serve territory between the Mississippi

# No WEAK LINK in MIDWESTERN'S CHAIN of PIPELINE SERVICE!

Midwestern accepts a responsibility for providing reliable products, equipment and service to pipe line companies and contractors the world over, **regardless of job conditions.**

So, also, do the manufacturers behind Midwestern's famous "name brands" of pipe line materials and equipment . . .

Glaskote . . . Coromat . . . Glasfab . . . Kermac . . . Kapco . . . Maloney . . . Keystone . . . each a superior product in its field.

Midwestern sales and engineering personnel are **field-trained** to understand your problems quickly and to act on them with efficiency. There is a Midwestern representative as near as your telephone — ready and able to serve your needs **wherever pipe lines are laid.**

## MIDWESTERN PIPE LINE PRODUCTS COMPANY

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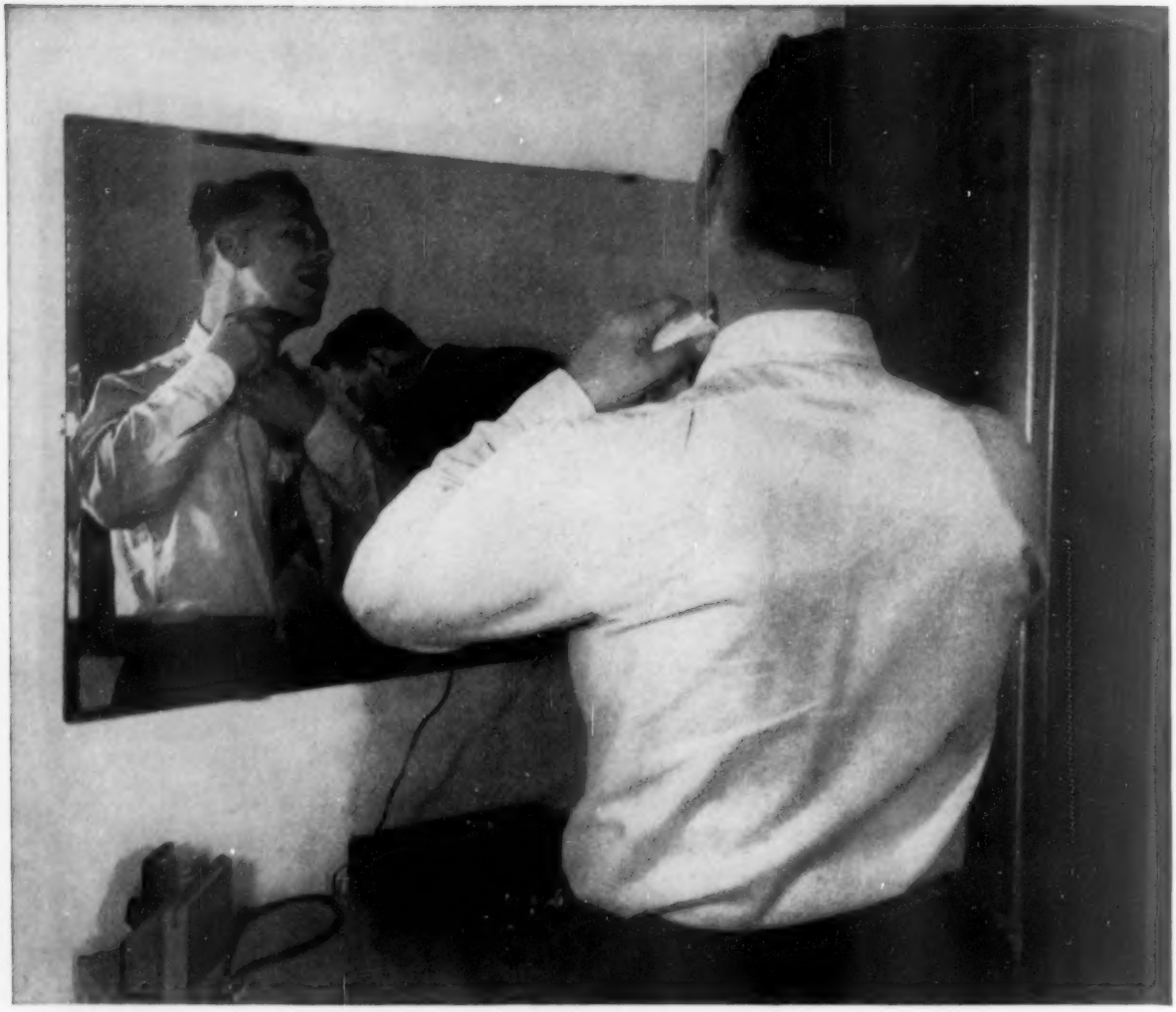

# "Think we ought to give the job to Pritchard again?"

"Listen, Mike, it's awful early in the morning and I haven't had coffee yet."

"That isn't a complicated question. What do you think?"

"Seriously, Mike. It's an unqualified 'yes'!"

"That's the way I feel about it. Better hurry and get that suitcase packed if we're going to catch that train."

"Then, too, they're a nice outift to work with."

"Right."

"And I like their package contract—responsibility for everything—engineering, design, drafting, construction."

"Right."

"And so I think it's Pritchard again."

"You left out the big thing. They've already built a compressor station for us with three gas turbine compressor units. 34,200 horsepower. Built at less than $250 per horsepower!"

"I'll let the Pritchard folks know our decision as soon as we get back to the office."

**J. F. PRITCHARD & CO.**
4625 Roanoke Parkway, Kansas City 12, Mo.

"Think we ought to give the job to Pritchard again?"

**PRITCHARD KNOWS HOW TO GET A JOB DONE RIGHT... RIGHT ON TIME!**

Time after time natural gas companies that have had any experience at all with the Pritchard organization have come back for more when they expanded or modernized.

Why?

Because Pritchard knows how to get the job done right, right on time.

And, Pritchard's complete package contract means that each part of planning and installation is done on a carefully co-ordinated engineering, purchasing and construction schedule.

Pritchard is ready to offer you the same type of high caliber planning!

**WRITE FOR PROOF!**

Write today for a typical example of how you save time and money with Pritchard's complete package contract.

INDUSTRY'S PARTNER FOR PROGRESS

SERVING THE GAS, PORTS, PETROLEUM AND CHEMICAL INDUSTRIES

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J.F. Pritchard & Co.
ENGINEERS • CONSTRUCTORS
Dept. 512, 4625 Roanoke Parkway
Kansas City 12, Missouri


River and the Rockies and from Canada to the Gulf of Mexico. Present plans include the production of metal-working chemicals: rust proofing and paint-bonding phosphate coatings, phosphate coatings to facilitate cold-forming operations, pickling-acid inhibitors, oil-well acidizing and corrosion inhibitors.

## Cooper-Bessemer Assigns Spetka to New York Office

The assignment of Richard L. Spetka to the New York domestic office has been announced by Robert F. Lay, vice president and general sales manager of The Cooper-Bessemer Corp., Mount Vernon, Ohio.

Spetka will assist in the engineering and sale of compressors and engines. His activities will be carried out under the direction of Charles M. Reagle, vice president and district manager, and George W. Edick, branch manager.

## Totco Transfers Stafford, Appoints Blankenship

The transfer of Stanley W. Stafford from Kansas to Oklahoma and the appointment of Norman C. Blankenship to serve the Kansas area have been announced by H. H. Peters, president of Technical Oil Tool Corp.

Stafford, a field representative who has been with Totco 1 year, will make his headquarters in Oklahoma City. Blankenship, who is experienced in drilling operations and oil-field supply, will be headquartered in Pratt, Kans.

## Graver Appoints Costello

T. J. COSTELLO

T. J. Costello has been appointed sales representative for Graver Tank & M a nufacturing Co., Inc., according to G. G. Byer, division sales manager. Costello will continue to be located in Tulsa.

## HTL Acquires TI Line of Recording Instruments

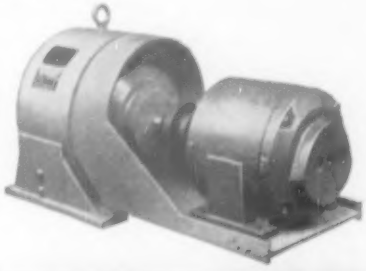
Transfer of the Texas Instruments line of ink-writing recording instruments from Dallas to Houston has been announced by Houston Technical Laboratories President R. W. Olson. In the future, this line of recorders will be produced and marketed by HTL, the instrumentation subsidiary of Texas Instruments. Recorders have many similarities to the line of geophysical instruments currently being manufactured at HTL, and the move is being


**Change MOTORS ...in Minutes**

**...with the Phillie Gear UTILITY GEARMOTOR**

Motors can be interchanged or replaced in a matter of minutes, merely by unbolting the old motor, separating the coupling halves, and bolting-on the new motor. No long and costly "down-time". Replacement of standard foot mounted motors is not limited to the original make of motor.

The Philadelphia "Utility" Gearmotor is of heavy, non-corrosive cast iron construction. The rugged design of the motor support eliminates alignment and vibration problems between reducer and motor. These Units are available with motors up to 60 h.p., in full range of AGMA output speeds—they can be furnished from stock for prompt delivery, either with or without motors. The "Utility" Gearmotor is equipped with the patented and widely used Philadelphia "Sphereflex" Flexible Coupling, which provides additional versatility of mounting. Send for complete Gearmotor Catalog, and be convinced.



PHILADELPHIA GEAR WORKS
INCORPORATED
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Virginia Gear & Machine Corp., Lynchburg, Va.
Industrial Gears & Speed Reducers • LoneTorque Valve Controls
Established 1887

made largely to centralize the manufacture of related items.

Among the persons being transferred from Texas Instruments in Dallas to Houston Technical Laboratories in connection with the recorder are Orm F. Henning and Ralph T. Dosher, Jr. Henning has been appointed HTL assistant sales manager, reporting to John D. Weber, and will be in charge of industrial instrument sales. Dosher has been appointed HTL assistant chief engineer, reporting to Dr. Hal J. Jones, and will be in charge of recorder development and design.

## Kendall to Build Polyken Tape Coatings Plant

A new million-dollar plant for manufacturing its Polyken plastic film and plastic adhesive tape coatings for corrosion prevention on gas lines, metal pipe, conduit and cable will be erected by The Kendall Co. on a 76-acre site in Franklin, Ky., Richard R. Higgins, president, has announced.

The initial unit will provide 35,000 sq. ft. of floor space. Truck docks, located at each end of the building, will expedite the flow of raw materials and finished product. A siding will lead in from the Louisville & Nashville Railroad.

In recent years, Polyken engineers have extended their interest beyond the product into the design of machines for the more efficient application of the product. Both hand powered and mechanized equipment are available for wrapping all diameters of pipe from ½ to 36 in.

## Wood Named Construction Manager by Stone & Webster

The appointment of Richard M. Wood as a construction manager, with headquarters at its Boston office, has been announced by Stone & Webster Engineering Corp.

First employed as a rodman by Stone & Webster in 1921, Wood has been an assistant construction manager at Boston since 1947. He has had extensive experience on power-plant work and industrial construction in various capacities.

## Strub Joins Fluor As Assistant to President

Paul T. W. Strub has joined Fluor Corp., Ltd., as assistant to J. S. Fluor, president of the engineering, construction, and manufacturing firm.

Prior to joining Fluor, Strub was assistant to the president of Calor Gas Co. His employment includes service with Standard Oil Co. (N. J.), Reconstruction Finance Corp.'s office of rubber reserve, and Great Lakes Carbon.

## GM Adds to Stewart & Stevenson Sales Area

Stewart & Stevenson Services has been awarded additional sales and service territory in Texas by the Detroit Diesel Engine Division of General Motors, Joe Manning, Stewart & Stevenson vice president and general manager, has announced.

R. E. Hunter, general sales manager of Detroit Diesel, notified the Stewart & Stevenson organization that the new territory would include the balance of the Panhandle area of Texas and eastern New Mexico. Stewart & Stevenson now services all of Texas except the El Paso area.

A new sales and service office is to be opened soon in Amarillo which will function as a part of the Stewart & Stevenson Lubbock branch operation. In addition to the main plant at Houston, Stewart & Stevenson has other Texas branches and offices at Corpus Christi, Dallas, San Juan, Odessa, San Antonio, Pecos, Tyler, and Longview.

PIPELINES are NOT SIDELINES with...
WILLIAMS BROTHERS
RECENTLY COMPLETED
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Colombia, South America
ENGINEERS and CONSTRUCTORS
OIL • GAS • WATER
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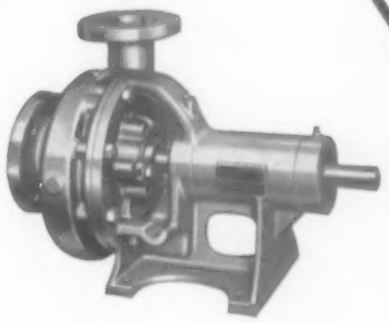
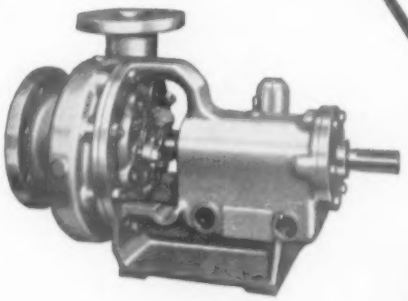
**Mr. Engineer: Cut Your Pump Inventory—Reduce Costs With These New, Proved Pumps**

# PEERLESS
# CHEMICAL PROCESS PUMPS



*type* **DL**
*grease lubricated housing*



*type* **DM**
*oil lubricated housing*

*Here is*
**INTERCHANGEABILITY IN ACTION—**

Interchangeability of component parts for DL-DM pumps is graphically shown by this slide selector. Write for your FREE copy. It shows how liquid end components are accommodated on either grease lubricated or oil lubricated bearing housings. Also provides quick reference to pump specifications and performance characteristics.

*a new concept of economy through interchangeability of components!*

## PEERLESS
## *type* DL & DM PROCESS PUMPS ALSO FEATURE:

**ACCESSIBILITY**—Through ease of assembly and disassembly if and when required. **DURABILITY**—Through use of any machinable metal as materials of construction. **SERVICEABILITY**—Through designs that feature maximum ease of maintenance. **INTERCHANGEABILITY**—Through a choice of semi-open or enclosed impellers, oil or grease lubrication, air-or water-cooled back plates and bearing housings. **RELIABILITY**—Through the high performance standards set for these pumps, proving more than ever before, that Peerless Builds Dependable Pumps. **AVAILABILITY**—Through shipment from stock of both complete pumps and pump components.

*Other pertinent Type DL-Type DM facts:*

Peerless Type DL and Type DM process pumps are available in 1", 2", 2½" and 3" sizes on an 8½" frame and in 1", 2", 2½", 3" and 4" sizes on a 10½" frame. **CAPACITIES**: up to 800 gpm. **HEAD RANGE**: up to 430 feet. **DRIVES**: motor or steam turbine. **TEMPERATURE RANGE**: grease lubricated housing up to 250°F.; oil lubricated housing up to 450°F. **WORKING PRESSURES**: up to 400 psig.

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PEERLESS PUMPS

**PEERLESS PUMP DIVISION**
**FOOD MACHINERY AND CHEMICAL CORPORATION**

*Factories: Indianapolis 8, Indiana and Los Angeles 31, California*
*Offices: New York, Chicago, St. Louis, Atlanta, Lubbock and Plainview, Texas; Fresno, Los Angeles, Phoenix, Albuquerque.*
*Distributors in Principal Cities. Consult your local Telephone Directory.*

fmc

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**Food Machinery and Chemical Corporation**
**301 West Avenue 26, Los Angeles 31, California**

**Please send chemical process pump selector DR-1**

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Company_____

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OGJ

**He's checking performance** of test samples of Unaflo Oil-Well Cement under simulated well-bottom conditions. These, and other tests, maintain Unaflo's consistent high quality and field performance.

# UNAFLO* quality-control means top field performance

Successful cementing in the field starts with quality-control in the laboratory. You get reliable performance when you specify Unaflo Oil-Well Cement, because Unaflo is carefully tested to maintain consistent high quality. This painstaking care during manufacture pays off in the field. In time of emergencies, oilmen are sure of vital extra time, because of Unaflo's *retarded set*. And Unaflo slurries pump easily from the start . . . stay fluid and pumpable under critical conditions of temperature and pressure. Yet, after the retarded period, Unaflo slurries form a strong, tight, sulphate-resistant seal. Unaflo complies with API STD 10A Specifications for oil-well cement, regular-type classes D and E. For typical data tables on Unaflo's down-the-well performance, and facts on our other cements, write:

**UNIVERSAL ATLAS CEMENT COMPANY**

UNITED STATES STEEL CORPORATION SUBSIDIARY

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*Albany · Birmingham · Boston · Chicago · Dayton · Kansas City · Milwaukee*
*Minneapolis · New York · Philadelphia · Pittsburgh · St. Louis · Waco*

*"UNAFLO" is the registered trade-mark of the retarded oil-well cement manufactured by Universal Atlas Cement Company.

U-142

PERFORMANCE-PROVED **Unaflo** RETARDED OIL-WELL CEMENT

United States Steel Hour—Televised on alternate Wednesdays—See your local newspaper for time and station.

In this corner . . . . . and here

# The Winner . . . The Runner-Up

## . . . in the A. A. P. G. emblem-design contest

**by Frank J. Gardner**

THE Lions have one. So do the Elks. The scouts, engineers, and even the Campfire Girls. But not the oil finders.

We're talking about emblems—those distinctive badges of identification that adorn the lapels of active members of any large organization. Not only are they worn on the lapel, but they appear on the organization's magazine, on its letterhead, its office door, and often on its cars . . . But the oil finders had none. Now, the American Association of Petroleum Geologists has taken action to fill the void.

**A certain challenge . . .** In the spring of 1955, the association's committee appointed an Official Emblem Committee to solicit designs. The committee, under the chairmanship of Carter Oil Co.'s Merrill W. Haas, immediately launched a world-wide contest, and organized a 20-man publicity team to spread the news. They offered prizes that would hardly attract a single entry on a television bout—$50 first prize and $25 second prize—but there was a certain challenge here that appealed to oil-company draftsmen. And they snapped it up. In the next 8 months, more than 200 designs poured into Haas' office. They came from all parts of the United States and from many other lands. While most of them originated in oil-company drafting rooms, there were others from geologists, geophysicists, housewives, and a few from the Good-Humor man. Anybody was eligible, whether a member of A.A.P.G. or not.

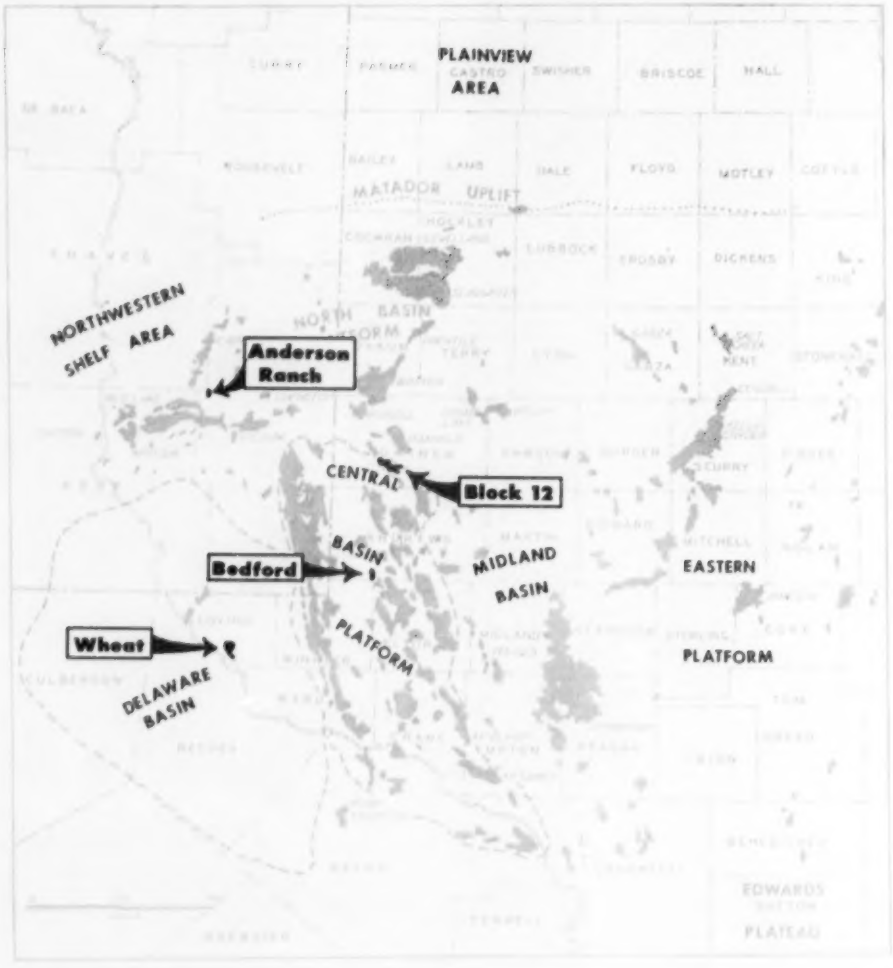
**Leads to a winner . . .** At its annual meeting in Chicago last month, the Official Emblem Committee displayed its selection of the top 20 designs and asked the delegates to vote for their choice of a winner. First prize went to S. W. Reims, draftsman for Standard Oil Co. (N. J.), New York; his design is shown, left above. By coincidence, the second-vote was also won by a New Yorker and a Standard Oil (N. J.) man, Fritz van der Leeden; his entry is to the right, above.

Both winners radiate appeal, and the race was close. The Reims design emphasizes the association's globe-girdling domain, and its effectiveness in fueling the world's industry. These factors, together with a greater adaptability to line-drawing reproduction, gave it an edge over the runner-up, a more esthetic medallionlike drawing that points up the oil finder's everyday activities.

**With imagination and adaptability . . .** Association members in Chicago found the voting far from easy. For the top 20 designs covered a wide range of objects and activities. There were fine-line sketches of Brunton compasses, derricks, hammers, globes, and outcrops; shaded designs of impressive artistic appeal; and a few geometrically perfect patterns that would out-engineer an engineer. But imagination and adaptability narrowed the field to these two.

Pending final approval by the executive committee of the A.A.P.G., the Reims emblem will be formally adopted and will become the universal badge of the rockhound. Mark it well. You'll be seeing it on stationery, lapels, office doors, ashtrays, dishes, door knobs, ribbons, watch chains, and . . . we'll venture to say . . . a few college sweater girls.

**The Permian basin today has a daily allowable of nearly 2½ million barrels of oil and produces over 20 per cent of the nation's oil. Areas described in the abstracts listed below are shown on the map. (Base map courtesy of Midland Map Co., Midland).**




The success of the recent oil-finders' convention at Midland, May 11-12, is proof that geologists and geophysicists have common interests and problems. Here the Journal gives its exploration readers . . .

# Selected Abstracts . . .

## . . . from the first joint meeting of the Permian Basin Geophysical Society and West Texas Geological Society

### Geophysical Characteristics of the Midland Basin, Texas

**JOHN DALY,** consultant, Midland, Tex.

BY definition, this discussion includes the Eastern Shelf area, and of necessity deals in generalities.

There are two principal problems involved in using the seismograph: getting records, and interpreting them. The first of these is largely a matter of surface conditions, which differ in the three broad physiographic categories into which the area is divided: the Llano Estacado, the Edwards Plateau, and the Osage, or Gypsum Plains, where the Ogallala, the Cretaceous Edwards limestone, and the Triassic and Permian red beds, respectively, outcrop.

While the remarks herein deal principally with the seismic method, the topographic characteristics, the distribution of surface and subsurface rocks, and their variations, are important factors in magnetic and gravity measurements and interpretations.

The seismic techniques in vogue today vary from single geophones and single holes, to multiple hole and geophone arrays. The multiple arrays are the equivalent of super-mixing circuits. In the Edwards Plateau and Osage Plains provinces, topography is a serious problem. Not only must the elevation difference be corrected, but, in some cases, higher velocities are observed in the upper 1,000 ft. of sediments in the topographically high places than in the drainage areas.

The seismograph is a potent tool for the solving of stratigraphic problems in the Permian and Pennsylvanian formations and both the barrier and biohermal-type reefs are found by this method. The widespread belief among geologists that reefs cannot be found by seismograph is refuted by the record. There are three avenues to reef exploration: (1) a study of the supercumbent materials; (2) a study of the reef itself; and (3) a study of the subcumbent formations. These are best used in coordination.

The seismograph is essentially an instrument for measuring differential dip, and its application to structural problems throughout the Midland basin and Eastern Shelf areas has been manifestly successful. Velocity changes are sometimes serious, and limit the effectiveness of the method.

### Provinces for Future Exploration In West Texas and Southeastern New Mexico

**WILLIAM A. WALDSCHMIDT,** consulting geologist, Midland, Tex.

THE major geological provinces of West Texas and southeastern New Mexico, and subdivisions thereof, are reviewed briefly in an attempt to select in a general way some of the areas that might be considered to be oil provinces for future exploration. Of the established geological provinces, the Delaware and Val Verde basins are considered worthy of additional exploration.

Some of the smaller areas, or subdivisions of the established geological provinces, also believed good for future exploration, include the east and southwest flanks of the Delaware basin, the west edge of the Eastern Shelf, the area along the west side of the Midland basin, and the large atoll-like trend at the

northern end of the Midland basin. The paper is concluded with suggestions that might be helpful in planning exploration in these areas.

## Magnetic Record Sections And Their Interpretations

**GLEN N. CONKLIN,** Sun Oil Co., Dallas.

IN an effort to present seismic data in such a manner that it can be understood more readily by others than seismologists, Sun Oil Co. has adopted the record section made up of magnetic records.

These records usually are corrected for weathering, elevation, and moveout and are mixed to enhance the appearance of the reflections. Sections are printed on paper for display purposes and sometimes continuity or lack of it is shown by colors.

Record sections for display include Oklahoma, South Texas, Louisiana, and Montana—each selected because a different problem is presented.

Sun now has all of its 14 company crews equipped with magnetic recording.

## Geology of the Midland Basin And Eastern Platform

**J. H. BARTLEY,** consulting geologist, Texas American Oil Corp., Midland, Tex.

THE Midland basin and Eastern Platform constitute two of the four major structural units of the South Permian basin. The relationship of these two units embraces numerous geological and geophysical correlation problems as a result of the erratic change in facies of both Permian and pre-Permian sediments, which, in the Permian section, grade principally from sandstones and shales in the Midland basin to limestones on the Eastern platform. The Upper Pennsylvanian sediments of the pre-Permian grade from shales on the eastern periphery of the Midland basin to bedded and "reef" type limestones associated with sandstones on the Eastern Platform.

A study of the tectonics of these two areas indicates a possible solution to some of the problems of correlation by virtue of (1) determining the structural age of prospective structures relative to the accumulation of oil or gas, (2) determining the types of oil and gas traps common to the area under investigation, both of which, when coordinated by the geologist and geophysicist, will assist them in determining the proper method of approach for interpretation of existing structural conditions.

## Geology of the Central Basin Platform

**MARSHALL L. MASON, JR.,** Union Oil Co., Midland, Tex.

THE Central Basin platform is a subsurface topographic feature defined by contours of the Permian dolomite. It trends northwest-southeast and is approximately 150 miles long and 45 miles wide. The platform has an areal extent of approximately 7,000 sq. miles.

The environment of the region in which the Central Basin platform was to appear was such that carbonates were the predominate type of rock deposited. The first orogeny that led to the forming of the Central Basin platform began in the late Mississippian and was contemporaneous with the Amarillo and Wichita Mountain movements. The results of this orogeny has been called the Pecos uplift. The uplift was more pronounced in the south in northern Pecos County and diminished in intensity northwestward. The folding was of sufficient magnitude to allow some erosion prior to the invasion of later Pennsylvanian seas.

The upper Pennsylvanian seas deposited carbonate rock adjacent to the more positive area so that thick "shoulders" of Pennsylvanian limestone parallel the trend of the Pecos uplift. At the end of the Pennsylvanian another orogeny occurred, further uplifting and faulting the features previously established and creating new structures. Some areas were lifted to such heights that erosion removed all Pennsylvanian and older strata down to the pre-Cambrian. This unconformity is among the most conspicuous in the Permian basin and is the key to the relationship of Permian to pre-Permian features.

The positive nature of the Pecos uplift and associated thick Pennsylvanian limestone development resulted in shallow Permian seas where additional carbonate section was deposited. Permian deposition occurred on a topography composed of eroded and faulted anticlines, detrital filled synclines and other features peculiar to a predominately carbonate environment. This foundation for Permian deposition, almost peneplaned over large areas, held within itself established zones of strength and weakness and to some extent and in many cases the growth of pre-Permian structures continued during Permian time, resulting in a close association of Permian with older folds. Thus, from the structural development and the deposition of carbonates during Permian time the geologic province—Central Basin platform—appeared.

During the upper Guadalupian, further restriction of the seas on the eastern portion of the platform resulted in the beginning of the evaporite facies in the Permian, while along the western rim of the platform the Capitan reef continued to build. In Ochoa time the Permian seas were confined to the extent that extensive salt strata were deposited.

The Upper Triassic lies unconformably on the Permian. Triassic rocks consist of interbedded red shales and sands, and are the largest terrestrial and fluviatile deposits on the Central Basin platform. No Jurassic deposits are recognized in the area.

The surface in the area of the platform is covered by Cretaceous, Tertiary, and Quaternary sediments. An invading Cretaceous sea covered the platform with uniform beds of limestone, shale, and a basal sand which subsequent uplift and extensive erosion reduced to remnants except on the southern end where the familiar bold escarpment of the Edwards limestone remains. The upper Tertiary overlying the Cretaceous remnant forms most of the surface of the Llano Estacado and is composed of caliche, sands, and gravels. The Quaternary of the platform is composed mainly of loose sand which rests unconformably on the Cretaceous and Tertiary in various places.

## Exploration History of the Block 12 Area, Andrews County, Texas

**J. H. DEMING,** consultant, and **L. O. DAILEY, JR.,** Atlantic Refining Co., Dallas.

THE authors review the general history of the Block 12 area, Andrews County, Texas, from the first geologic interest in the area in 1920 to the present time. Successive torsion balance, gravimetric, and seismic mapping are presented and discussed. Subsurface geologic mapping and a geologic cross-section based upon well control are also presented with a summary of the generalized stratigraphy.

The authors call attention to a seeming correlation between progressive changes in reflection character and truncation of geologic markers.

## History and Development of Bedford Field, Andrews County, Texas

**C. G. COOPER** and **L. F. UHRIG,** Shell Oil Co., Midland, Tex.

BEDFORD multipay field, in Andrews County, Texas, affords an excellent example of close agreement between an original seismic interpretation and subsurface structure revealed by exploitation. Reflection seismic work, employing the continuous profile technique, was done by Shell Oil Co. in 1939 and 1944.

On November 1, 1945, the discovery well, Shell-Texas 1 Ratliff & Bedford, was completed as a successful dual producer from the Devonian and Ellenburger formations.

Subsequent development of the field followed an orderly program of exploitation during which drilling was successfully guided by close coordination of seismic and subsurface data.

Fourteen wells have been completed, and by the end of 1953, 5½ million barrels of oil had been recovered.

## Geology of the Northwestern Shelf

**RANDALL MONTGOMERY,** New Mexico Oil Conservation Commission, Hobbs, N. M.

THE Northwestern Shelf of New Mexico is north of the Artesia-Vacuum Trend, and the San Simon Channel. The eastern border is defined as the North Basin platform. The western margin is less well defined, but regionally dips southeast from the Pedernal Massif. The northern boundary is well defined by the Matador uplift. Within the Northwestern Shelf is the Lovington Synclinorium which is defined as that area bordered by the Knowles-Crossroads Positive on the east, and the Saunders-SRR Positive on the west. The Lovington Synclinorium has some 3,000 ft. more sedimentary section than the surrounding positive areas.

All major sedimentary units thin north and west from the northern limits of the Guadalupian reefs except in the Lovington Synclinorium where the Mississippian, Pennsylvanian, and Wolfcamp sediments become more clastic and thicker. The lower Paleozoic rocks pinch out north and northwestward as the Permian sediments increase in evaporites and continental red beds.

The Northwestern Shelf is presently producing 45 per cent of New Mexico's oil, but as to accumulative production, it accounts for only 12 per cent. This reflects the recent rapid growth of the area. The production is obtained primarily from Devonian and Permo-Pennsylvanian sediments.

## Wheat Field, Loving County, Texas

**G. T. BOWEN,** Standard Oil Co. of Texas, Midland, Tex.

WHEAT field is located in the middle of the much exploited Delaware basin. It is almost unique in its structural relationship as an oil trap, extremely thin pay section, long life and yield per acre.

Operations are now under way to obtain production by secondary-recovery methods.

## Geophysical Characteristics Of the Northwest Shelf

**LORENZ SHOCK,** Midland Geophysical Co., Midland, Tex.

THE geophysical characteristics of the Northwest Shelf are closely related to the surface and near-surface formations. In the west and north parts of the area, the sur-

face is generally sand or sandy clays, and standard techniques yield fair to good results.

In the south and southeast where caliche is exposed at the surface, specialized techniques involving offsets, or multiple holes and geophones, generally are required.

Since most of the interesting structural features are relatively steep-sided and complicated by faulting, close detail and extreme care of record quality are required to provide satisfactory interpretation.

### Exploration Case History of Anderson Ranch Field, Lea County, New Mexico

**GLEN H. SWENUMSON,** division geophysicist, Continental Oil Co., Roswell, N. M.

THE Anderson Ranch area was first pointed up as anomalous by an unusually high Rustler anhydrite point in a shallow well drilled in 1927. In 1940, core drilling confirmed an anhydrite nose over the area. In 1950-51, a reflection seismograph survey, despite many difficulties in obtaining usable records, succeeded in mapping a closed anticline. It is quite certain the deepest seismograph map was based on multiple reflections. Some comments are offered in this regard, and exaggerated "structure" shown on the multiple reflections is pointed out. The anticline was unitized and drilled, the discovery well being completed in the Devonian, for an initial production of 1,968 bbl. of oil per day.

### Petroleum Geology of the Delaware Basin

**T. F. HARRISS,** consultant, Midland, Tex.

THE Delaware basin of western Texas and southeastern New Mexico is a large and relatively little-explored subdivision of the petroleum-rich Permian basin. Exploration has been delayed for various reasons, including the depth to pre-Guadalupe objectives, the general lack of closed structures at the top of the Guadalupe, and the thickness and character of the post-Guadalupe mantle. The latter has been a formidable obstacle to geophysical exploration.

Expensive exploration and deep drilling require careful predictions of the location and size of petroleum reserves in the Delaware basin, based on geological comparison with more thoroughly explored areas. For example, the Delaware basin is far enough west to be in a disturbed zone extending south from the Rocky Mountains, resulting in some important differences from the geologically similar Midland basin.

### Geophysical Characteristics Of the Delaware Basin

**W. A. McFADDEN, JR.,** Midland, Tex.

SEISMIC work continues to vary between difficult and impossible in the Delaware basin area of southeastern New Mexico and West Texas. Transmission of seismic energy is complicated to the point of no return by the erratic lower surface to the Quaternary fill, at the base of which seismic velocity contrasts on the order of four to one have been observed. The Permian evaporite section is a further complicating factor. Solution of the resulting problems will still require time and the expenditure of a great deal of well-directed effort and money.

Gravity and magnetic surveys should be of value. These surveys require careful planning and execution. Only work of the highest quality should be considered acceptable. Emphasis should be placed on thorough interpretation by experienced personnel.

**J. H. BARTLEY, consulting geologist Texas American Corp., Midland . . . "... white spaces on the map will be filled with new pools when we start looking for different type traps . . ."**

**MARSHALL L. MASON, Union Oil Co. of California, Midland . . . "Central Basin Platform fields have produced 3½ billion barrels of oil, and we have just scratched the surface."**

# Permian Basin Oil Finders Meet

## Over 800 delegates register for parley

**Carl Hoot**

MIDLAND.—Joint consultation between geologists and geophysicists is rapidly gaining in favor, and management should be sold on the benefits of having the two groups working together in finding new oil.

This was the central theme at the first joint exploration meeting of the Permian Basin Geophysical Society and West Texas Geological Society. Over 800 delegates registered here for the 2-day meeting on May 11 and 12.

Papers were presented to outline the problems facing each of the exploration groups, and current and probable future ways of solving them. An open panel discussion did much to clear up individual questions.

It was evident from the discussion that drilling in the Permian Basin of West Texas and Southeast New Mexico is far from being on the down-hill grade. Improved methods, combined with new thinking will continue to bring in new pools in unexplored areas, and make for more recoverable oil in the developed fields.

The Permian basin currently is producing 20 per cent of this country's daily oil output, and its oil finders are bent on keeping it in that position.

**Where to from here . . .** The Delaware basin, which underlies a portion of West Texas and New Mexico, still holds much promise. Gas-distillate wells at Bell Lake in Lea County, and in Toyah field in Reeves County, plus a probable gas-distillate discovery by Shell on the basin's eastern rim, point to the possibility of its gas resources being more valuable than its oil. Successful completion of Shell's test, located in Winkler County, will stimulate a search all along the eastern side of the basin for pinchout-type traps.

**Val Verde basin . . .** This basin, of which the oil finders know very little, is thought to cover most of Terrel, Val Verde, and parts of Crockett and Sutton counties. It is considered by many companies as being a hopeful future oil province.

Wildcat interest in this basin has been given a boost by Magnolia Petroleum Co.'s recent gas discovery in northwestern Val Verde County. The well was not so much as gassers go, but important in that it introduced the first Ellenburger production in that county.

**Central Basin Platform . . .** This old area has produced over 3½ billion barrels of oil, but the peak is not yet, according to presented studies. The 150-mile long uplift has room for many new discoveries, a projection borne out by exploration developments over the past year, plus many good wells in new pays in old areas.

*(Abstracts of principal papers at this meeting start on page 284)*

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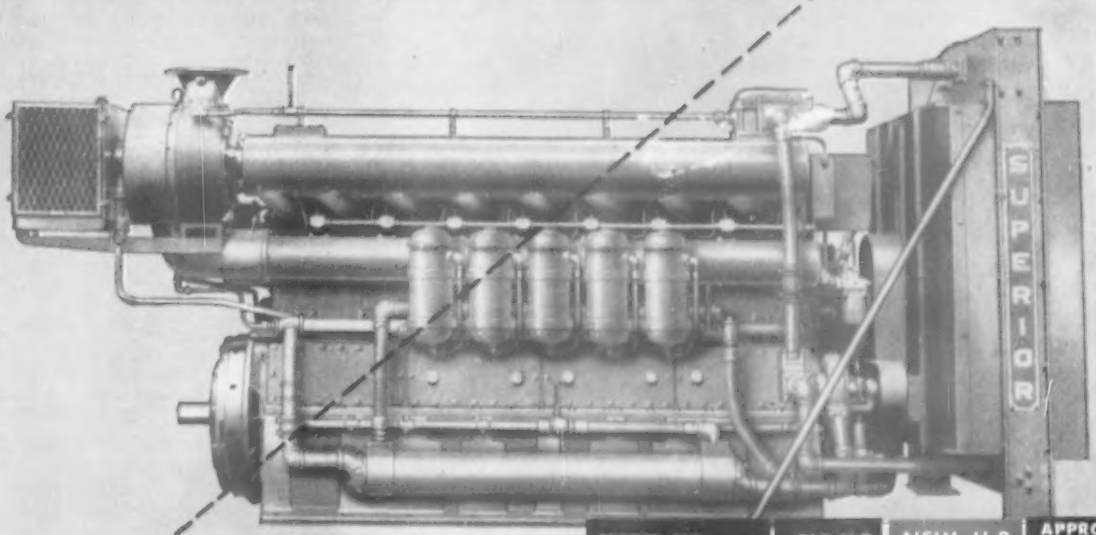


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# EXPLORATION HIGHLIGHTS

## APPALACHIAN

### PENNSYLVANIA

Banks Township, Indiana County, Southwest Pennsylvania, Columbian Carbon Co. 1831 Farmers & Miners Trust Co., deep wildact test has started drilling again with cable tools and is at 7,433 ft.

● In Armstrong Township 1833 Susie Yosurack, is at 814 ft.

● In Young Township, Manufacturers Light & Heat Co. 4336 Stewart & R. & P. Coal Co., at 1,234 ft., is rigging up to resume drilling with rotary outfit.

### WEST VIRGINIA

In Williamsburg district, Greenbrier County, West Virginia, Columbian Carbon Co., is moving in at 1235 Pattie Baevers et al., rank wildcat, elevation 2,313 ft., Clintonville Quadrangle 1.47 miles south of latitude 37 degrees 55 minutes and 1.90 miles west of longitude 80 degrees 30 minutes.

● Licking district, Tucker County, Hope Natural Gas Co., 9985 J. H. Ludwick, is drilling at 2,420 ft.

● No. 9993 E. Fike, elevation is at 1,130 ft., in the Benson sand which was topped at 1,110 ft.

### OHIO

A producer completed in the village of Walhonding, New Castle Township, Coshocton County, will cause several wells to be drilled, both in the village and on adjoining property, but lots have been consolidated and no close drilling is expected. The well was drilled by Roy B. Weed et al. on C. C. Spurgeon, and Clinton was logged at 2,935-3,011 ft. with a gage of 325 bbl. in a 24-hour test after fracturing. In Perry Township, the Natol and SHUFF and Bucy 4 Lowell Mizer extended West Carlisle pool a location to the north. Sand at 3,211-3,247 ft. was Fraced and gaged 60 bbl. in 24 hours.

Mutual Oil and Gas Co. moved out a location to the southwest from production in Fallsbury Township, Licking County, and completed a 106-bbl. well on 2 E. Frost, section 7. Clinton at 2,826-2,850 ft. gaged 3 bbl. before treatment.

## EASTERN INTERIOR

### Five Oil Pools Discovered In Illinois in April

Five new oil pools were discovered in Illinois in April, according to the State Geological Survey Division of the Department of Registration and Education. The new pools are Ashmore East in Coles County, producing from a Pennsylvanian sandstone; Bourbon in Douglas County, producing from the Rosiclare sandstone; Ewing East in Franklin County, producing from the Ohara limestone; and Sorento South and Sorento West in Bond County, both producing from a Devonian sandstone.

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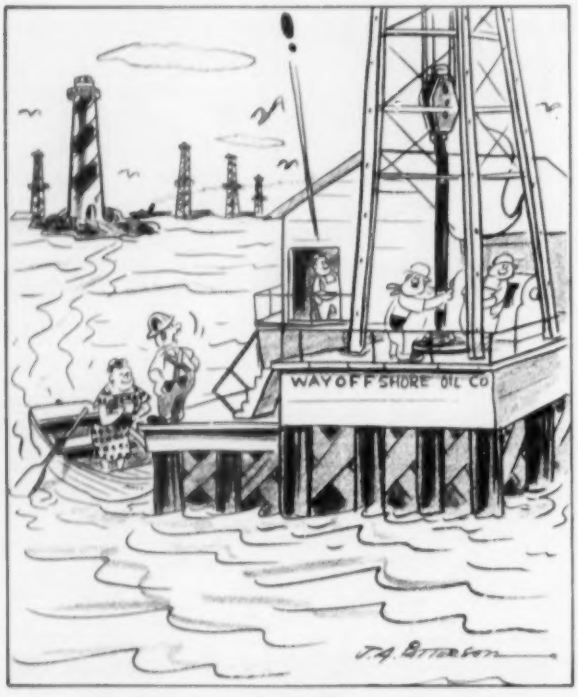
THE OIL AND GAS JOURNAL

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There were eight extensions to pools in April; two to Cooks Mills Consolidated and one to Mattoon, all in Coles County, and one each to Bungay Consolidated and Dale Consolidated in Hamilton County, Clay City Consolidated in Jasper County, Iuka West in Marion County, and New Memphis South in Washington County.

As road and weather conditions improve, the rate of drilling has been increasing rapidly. In April (a 4-week period), 318 wells were completed, or about 80 per week. During March, about 60 wells per week were completed. The 318 wells completed in April included 147 oil wells and 1 gas well

Oil production has remained at a fairly constant level for the past few months. Production for April is estimated at 6,910,000 bbl., approximately 230,000 bbl. per day. During the first 4 months of 1956, crude-oil production was about 2,000,000 bbl. more than for the first 4 months of 1955. Over $80,000,000 worth of oil was produced between January 1 and May 1, 1956.

The Cooks Mills Consolidated area in Coles and Douglas counties is the most active area in the state at present. During April, 23 oil wells, 1 gas well, and 12 dry holes were completed in the Cooks Mills Consolidated pool, and at the end of the month, 30 wells were drilling in the pool. Three sandstones are productive; the Rosiclare is the commonest pay, and the Cypress and Aux Vases also produce oil and gas. Wildcat drilling in the vicinity of the Cooks Mills Consolidated pool resulted in discovery of the Bourbon pool in April. Two wells were completed in April, and several others were near completion at the end of the month.

Harco pool in Saline County had 13 oil wells completed in April, including one with an initial production of 1,200 bbl. and one with 958 bbl., both from the Aux Vases sandstone.

## MID-CONTINENT

### OKLAHOMA

### Drilling Outlook Excellent Throughout Sooner Area

With summer nearly here and the year nearing the halfway mark, exploratory and development drilling in Oklahoma is running at a fast clip. Development work is running higher than normal in most sections of the state. New discoveries in various provinces within the state are paving the way for a further increase in impor-


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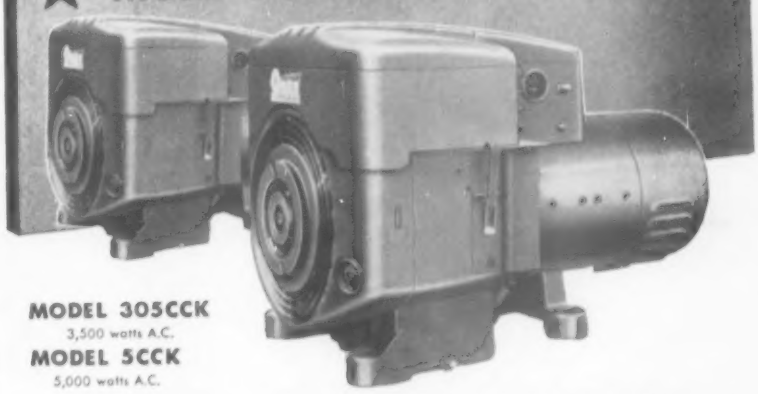

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tant development drilling for the remainder of the year.

The outstanding work areas in Oklahoma are Harper County in the northwest, the northern trend in Grant and Alfalfa counties, Cleveland County's Short Junction field, the area of Caddo County west of Cement field, the Knox district in Grady County, Kingfisher County, and the Garber area.

**Harper awakens . . .** One of the year's promising success stories is being written in northwestern Oklahoma's new Pennsylvanian area of Harper County.

Most of the development is centered in the east part of 26n-25w, near Laverne. It is estimated that ultimate gas recoveries in this fast-growing reservoir will be more than one million dollars per well. The Laverne discovery area has several pay zones, the Morrow being the most sought after so far. Depths range from 4,200-6,800 ft.

Gulf Oil Corp. completed the 1 McClung in SE SE NW 23-26n-25w, as a Morrow oil discovery from 6,922-32 ft. The well also made 3,000 M.c.f. of gas per day. Other pay zones appear commercial in the well, also.

Sunray Mid-Continent Oil Co. has a Hoover sand gas discovery at 1 Barby in SE SE 12-26n-25w. This well flowed 9,000 M.c.f. of gas per day from 4,205-15 and 4,225-54 ft.

**Cherokee trend . . .** The Cherokee sand play in northern Oklahoma's Grant and Alfalfa counties continues to expand. The 30-mile play now extends across 28n-5w, 28n-6w, 28n-7w, 28n-8w, and 28n-10w. It is expected by most that the area will cover more than 40,000 productive acres.

**Short Junction . . .** The score at this Cleveland County field is 130 Hunton oil wells. The activity centers in 10n-4w, with production at the 8,000-ft. mark. The field is far from being fully developed.

**Cement area . . .** Amerada Petroleum Corp. has an important discovery west of Cement field in Caddo County at 2 Young, SE NE SW 19-6n-10w. A solid sand interval is reported at 8,170-8,345 ft. The gas discovery has not been gaged as yet. The first development well around the new discovery is the 1 Gish in NW SE NW 19-6n-10w. It will go to 9,000 ft. The well flowed 9,000 M.c.f. of gas per day on tests.

**Knox . . .** British-American Oil Producing Co. discovered Bromide oil at 15,000 ft. at a wildcat in 29-3n-5w. A brisk lease-buying spree followed the discovery, with development expected to be active.

**Lovell . . .** Tennessee Gas Transmission Co. completed a Layton sand discovery at 1 Oltmans in NE SW NE 24-18n-5w, Kingfisher County, several miles from production. The discovery flowed 241 bbl. of oil in 24 hours from the Layton sand at 5,396-5,418 ft. From the Skinner sand the discovery made 2,425 M.c.f. of gas per day at 6,032-42 ft.

**Garber deep test . . .** Sinclair Oil & Gas Co. has a deep discovery in the Garber area. The 33 Denker in NW NW SW 13-22n-4w, flowed 70 bbl. of oil per hour from second Wilcox sand perforations at 4,528 ft. Brisk development is expected around this discovery.

## Short Junction Report

Continental Oil Co. took final production test at the 4 Liston in Short Junction field, Cleveland County. The Bois d'Arc well flowed 223 bbl. of oil per day on 10/64-in. choke from perforations at 8,010-54 ft. Location is C NE SW 24-10n-4w.

Another field well was completed at R. A. Hefner, Jr., 3 Zurline, C SE NW 9-10n-4w. The well flowed 110 bbl. of oil in 12 hours on 18/64-in. choke from perforations at 7,950-77 ft.


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The tripping mechanism in the SEALED TYPE "I" BOWEN JAR SAFETY JOINTS is a straight pull mechanical type.

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Because the tripping mechanism is purely mechanical, heavy blows can be struck despite packing failures or high temperatures and the same heavy blows will be delivered regardless of whether the string is elevated slowly or rapidly.

The tripping pull can be increased while the tool is in the hole or the tripping pull can be either increased or decreased while the complete tool or just the Bowl Assembly is at the surface. After considerable use, the wearing parts in SEALED TYPE "I" BOWEN JAR SAFETY JOINTS can be replaced easily and economically and the tool will regain all the properties of a new one.

**OUTSTANDING ADVANTAGES AS A SAFETY JOINT**

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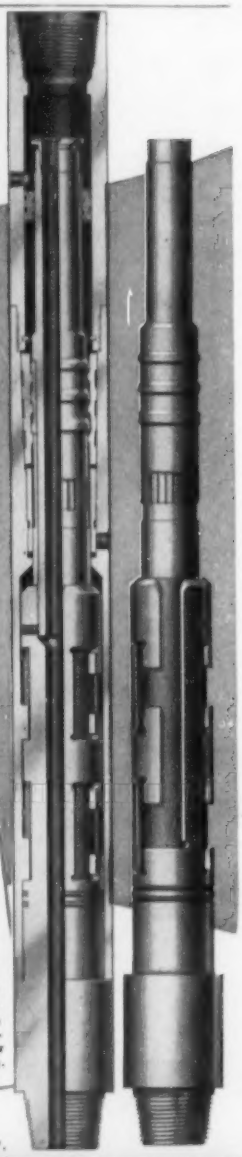
At the will of the operator, the Bowl Assembly can be separated from the Main Mandrel Assembly of the tool to salvage all of the string that is above it.

Later the Bowl Assembly can be reengaged with the Main Mandrel Assembly in the hole for subsequent recovery operations.



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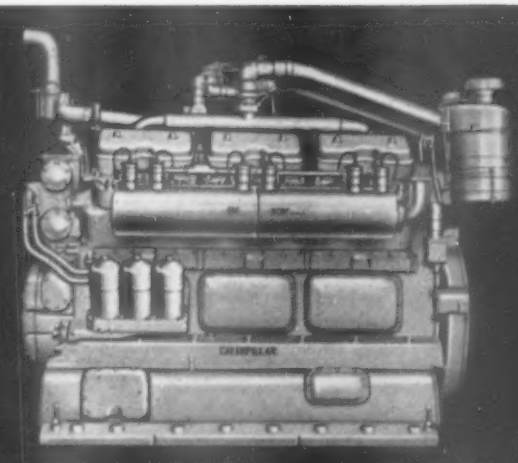

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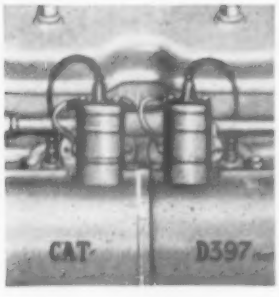


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Benson and Montin have a well at 3 Williamson, C SE SE 9-10n-4w. This well flowed 117 bbl. of oil in 18 hours after fracturing from perforations at 8,010-40 ft.

## Outpost Well Completed At Southeast Maysville

Daubes' Oil Department completed an outpost well in Southeast Maysville field, Garvin County, flowing 600 bbl. of 39°-gravity oil per day from perforations at 6,294-6,304 ft.

The 1 McDaniel, SE NE SW 27-4n-2w, was drilled to 6,430 ft., casing landed at 6,422 ft.

### NORTH TEXAS

## Recompletion Well in Wise Area Completed

Lone Star Producing Co. 1 Craft-Waterboard Unit 2, 8 miles southwest of Bridgeport in Wise County, was recompleted as an oil discovery with production in the Atoka conglomerate at 5,023-28 ft. The discovery well flowed 38 bbl. of 42°-gravity oil daily on 16/64-in. choke. The new discovery area will be called Boonsville-Atoka Conglomerate.

This well was completed last fall as a gas well from conglomerate at 5,873 ft. Location is in the John Grunder Survey A-325.

## New Pay Found at Sherman 8,800 Ft. Field

A new pay zone for the Sherman 8,800-ft. field in Grayson County was established at H. L. Hunt's 2 Crow, opening Sherman Penn-Ord field. The new pay is the Ordovician.

The discovery well flowed 181 bbl. of 39°-gravity oil per day on 10/64-in. choke from perforations at 8,893-8,911 ft. Gas-oil ratio is 1,200:1. Official gage on another zone in the Ordovician was 257 bbl. of 32°-gravity oil per day on 10/64-in. choke. Perforations in the lower pay zone were at 9,370-9,497 ft. The new discovery is 4½ miles northwest of Sherman in the J. N. Spencer Survey, A-1154.

# WEST TEXAS-NEW MEXICO

### WEST TEXAS

## Spraberry Producer Completed in Reagan County

Texas American Oil Corp. and Rutter and Wilbanks Bros. 2-35 Nunn, Section 35, Block B, L&SVRR Survey, Reagan County, Texas, flowed 360 bbl.

of oil per day on official 24-hour potential through 24/64-in. choke. This well is producing from the Spraberry formation through perforations from 6,382 to 6,532 ft. after fracture treatment with 21,000 gal. The gravity of the oil was 40.6° with a gas-oil ratio of 880:1. The new well is a ½-mile east stepout to production in the Spraberry Clearfork trend area.

## Southwestern Irion Area Gets Clearfork Hit

A flowing Clearfork sand oil discovery was assured Irion County at Mark A. Eidelbach 1 Edward J. Ashe.

The discovery flowed oil at the rate of 20 bbl. per hour on a 50-minute drill-stem test at 4,600-4,753 ft. Clearfork was topped at 4,533 ft. Nearest similar production is 3 miles northeast in Sugg field.

## World, West-Strawn Field Gets Good Extension Well

An extension well to World, West-Strawn field in Crockett County was completed by Cities Service Co. 15 miles southwest of Big Lake.

The 4-E Shannon, 18-Q-EL&RR, a ⅜-mile southwest extension, completed flowing 590 bbl. of 47.5°-gravity oil per day from perforations in the Strawn at 8,118-42 ft.

## Reeves' Toyah Gas Field Adds Fifth Producer

The fifth gas well in Toyah-Devonian gas field, Reeves County, Delaware basin, is flowing gas on drill-stem test from perforations at 12,590-12,660 ft. The well is Gulf Oil Corp.'s 1 H. E. Fuller, 48-55-5n-T&P, 8½ miles northeast of Toyah.

## Reeves County Discovery

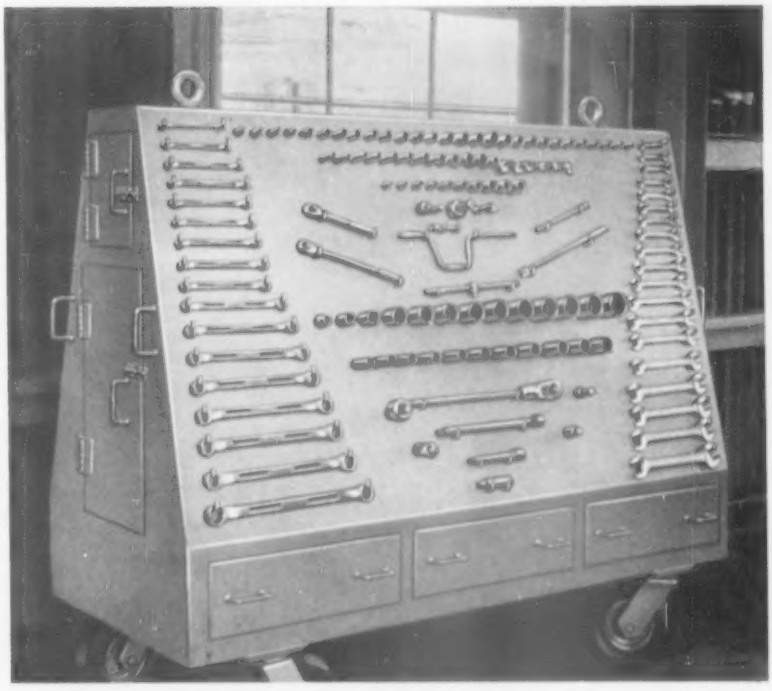
Reeves County gained a Delaware sand discovery at Marine Gathering Co. 1 TXL, in 2-54-4-T&P, 16 miles northwest of Pecos.

It was finaled for a daily pumping potential of 20 bbl. of 34°-gravity oil, plus 80 per cent water, with gas-oil ratio of 170-1.

Production was through perforations between 4,114-18 and 4,120-24 ft., which had been fractured with 3,000 gal.

Gulf Oil Corp. prepared to run casing for completion as a ¾-mile northwest extension and fifth producer for the Toyah (Devonian) gas field of Reeves County, at 1 Fuller, in 48-55-5n-T&P, 8½ miles northeast of Toyah.

On a 6-hour drill-stem test of the

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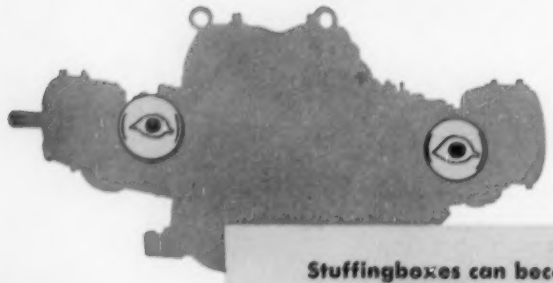

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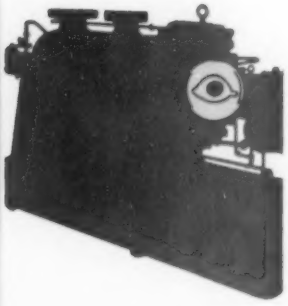

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Devonian between 12,660-12,760 ft. gas flowed at the rate of 7,850 M.c.f. per day.

## Gas Flows from Strawn At Irion County Offset

British American Oil Producing Co.'s 2 Noelke, a southwest offset to the 1 Noelke discovery well of 67-Strawn lime field in Irion County, flowed gas and recovered oil on drill-stem test in the Strawn at 6,917-27 ft.

Recovery on the test was 3,300 ft. of free oil. Location is 10 miles southwest of Mertzon in the Tom Green CSL Survey.

## Devonian Oil Flows at New Gaines County Hit

David Fasken 1 E. H. Jones, northwestern Gaines County exploratory test, flowed oil on drill-stem test at the top of the Devonian. The well flowed oil at the rate of 50-60 bbl. per hour on test at 11,155-87 ft. Location is in Section 31, Block AX, PSL Survey, northwest of North Russell-Devonian field.

## Andrews Wildcat Coring Ahead

Humble Oil & Refining Co. 1 Armstrong, Andrews County wildcat, is coring ahead after flowing oil on test of the Wolfcamp. The well flowed 45 bbl. of oil in 4 hours on ¼-in. choke on a test at 9,359-94 ft. with tool open 5 hours and 20 minutes. During the last hour the well made 17 bbl.

The new Humble discovery prospect is 5 miles from nearest similar production. Another test at 9,179-9,217 ft. flowed Wolfcamp oil, also. Location is in Section 11, Block A-45, PSL Survey.

## Extension to North Monahans Completed

Significant production from an extension well in North Monahans field, West Texas, has been reported by Stanolind Oil & Gas Co.

Stanolind 23-A Sealy Smith Foundation, located in Section 51, G&MM-B&A Survey, Winkler County, flowed 381 bbl. of 43° - gravity oil a day through a 20/64-in. choke on a production test.

The well was completed in the Ellenburger with top of pay at 12,501 ft., total depth 12,795 ft. and plugged-back total depth 12,750 ft. Perforation depths were not immediately available.

The well extends production in North Monahans field ½ mile north-


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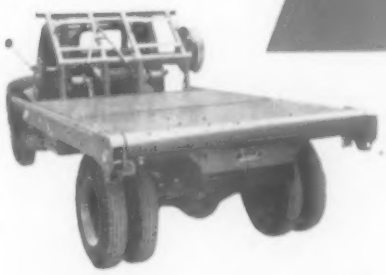

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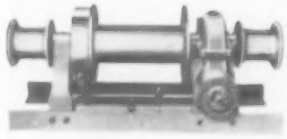

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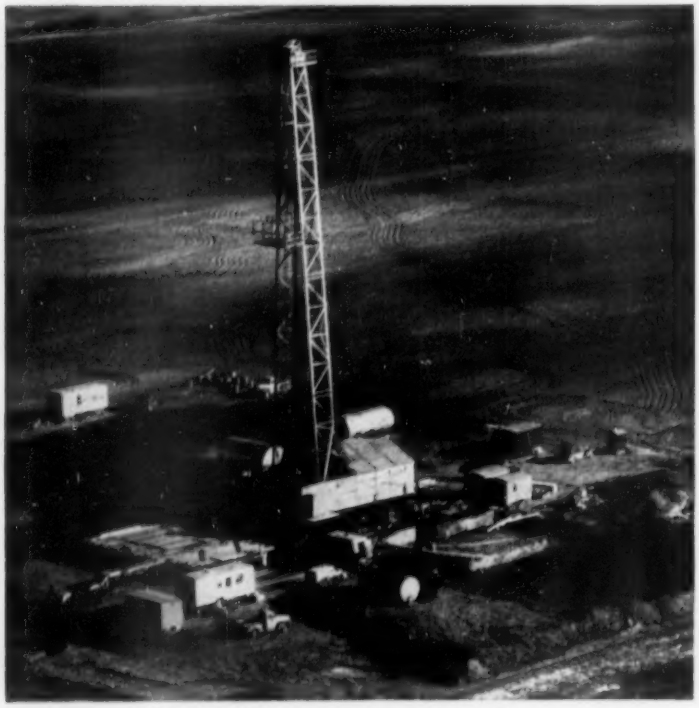
# Shadows spell wealth on Canadian prairies



Over vast plains where evening shadows once silhouetted ancient trails worn by the buffalo herds, the tracks of bulldozers tell the story of thousands of oil and natural gas properties that are bringing wealth from Canada to the world.

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west. Stanolind owns full interest in the well and has 5,360 acres in the area.

## Sinclair Has Prolific Prospect in Andrews

Sinclair Oil & Gas Co. has a prolific discovery prospect at its 2 University "212," SW SW Section 30, Block 9, University Lands Survey, Andrews County.

The Ellenburger discovery topped the Ellenburger at 12,330 ft., showing for good production. Previously, the strike made 5,800 ft. of oil on test at 11,420-510 ft. in the Fusselman. Location is on a 160-acre tract for which Sinclair paid record bonus at University lease auction. The tract joins the Emma and Triple N pre-Permian pays.

### SOUTHEAST NEW MEXICO

## Two Discoveries Seen In Lea County Tests

A new Pennsylvanian discovery and a Wolfcamp discovery are in prospect for Lea County.

Humble Oil & Refining Co. 1 South Four Lakes Unit, 2-12s-34e, 6 miles east of Bagley-Siluro-Devonian field, flowed 389 bbl. of 44.3°-gravity oil in 12 hours on drill-stem test of Pennsylvanian, probably Canyon sand, perforations at 10,227-57 ft. Flow was natural on ⅜-in. choke.

D. D. Feldman Oil & Gas Co. 1 Federal in 27-11s-38e, 5 miles northeast of Gladiola, flowed 52½ bbl. of oil in 12 hours on test of the Wolfcamp through 24/64-in. choke from perforations at 9,446-80 ft. On 24-hour test through same choke the well flowed 75.5 bbl. Tests continue.

# ARK-LA-TEX

### EAST TEXAS

## New Well Added to West Slocum Area

A new Woodbine oil well has been completed in Anderson County's West Slocum pool: Oil Properties, Inc., 1 Springman, on the William R. Wilson Survey, A-66, 2.5 miles southeast of the town of Slocum, flowed 291 bbl. of 44.2°-gravity oil per day on 14/64-in. choke. Perforations are at 5,687-90 ft.

**Cass County . . .** F. R. Jackson 1 George W. Morse, James Taylor Survey, A-1029, is a Hill sand oil discovery 1½ miles east of Haynes field in Cass County. The well flowed 360 bbl. of oil per day on ¼-in. choke from perforations at 5,952-62 ft.

**Smith outpost . . .** An east outpost to Good Omen field in Smith County has been completed by Sam Trant. The 1 Names Franklin, 2½ miles southwest of Arp on the Maria G. Henriquez Survey, A-11, flowed 313 bbl. of 43°-gravity oil per day on 12/64-in. choke. Perforations are at 8,072-80 ft. The well will be dually completed later from upper Pettet at 8,040-48 ft.

**Rusk County . . .** La Gorce Oil Co. and Bill R. Tipton 1 Eva Jordan et al is a gas discovery prospect on the east flank of Gum Springs field in Rusk County.

A test at 3,510-3,640 ft. recovered gas from what is believed to be the Woodbine sand. This new gas strike is 8 miles southwest of Henderson on the Jesse Crawford Survey.

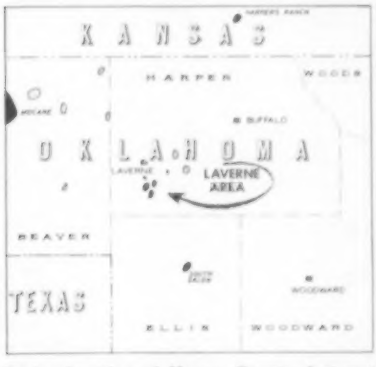
## HUGOTON EMBAYMENT

### NORTHWEST OKLAHOMA

### New "Beaver" Gas Region Shaping Up in Harper

Northwestern Oklahoma is in line for another Pennsylvanian and Mississippian oil and gas-distillate region similar to the development in Beaver County. The new area is in Harper County's Laverne district, just east of Beaver County.

Sunray Mid-Continent Oil Co. opened the Laverne play in 1952 at the 1 Wolfe. This Morrow discovery flowed 47 bbl. of distillate per day and 5,500 M.c.f. of gas from perforations in the Morrow sand at 7,190-7,230 ft. The discovery opened South Laverne field. Later, a well about 1 mile southeast opened Southeast Laverne field, also a Morrow gas producer. Following these discoveries a drilling lull settled down in the region. Not until this year did activity flare up again at Laverne. Late in 1955 Sun Oil Co. reopened




**Regional setting of Harper County, just east of the Oklahoma Panhandle in northwestern Oklahoma shows location of new pre-Permian play in relation to the Mocane area of Beaver County.**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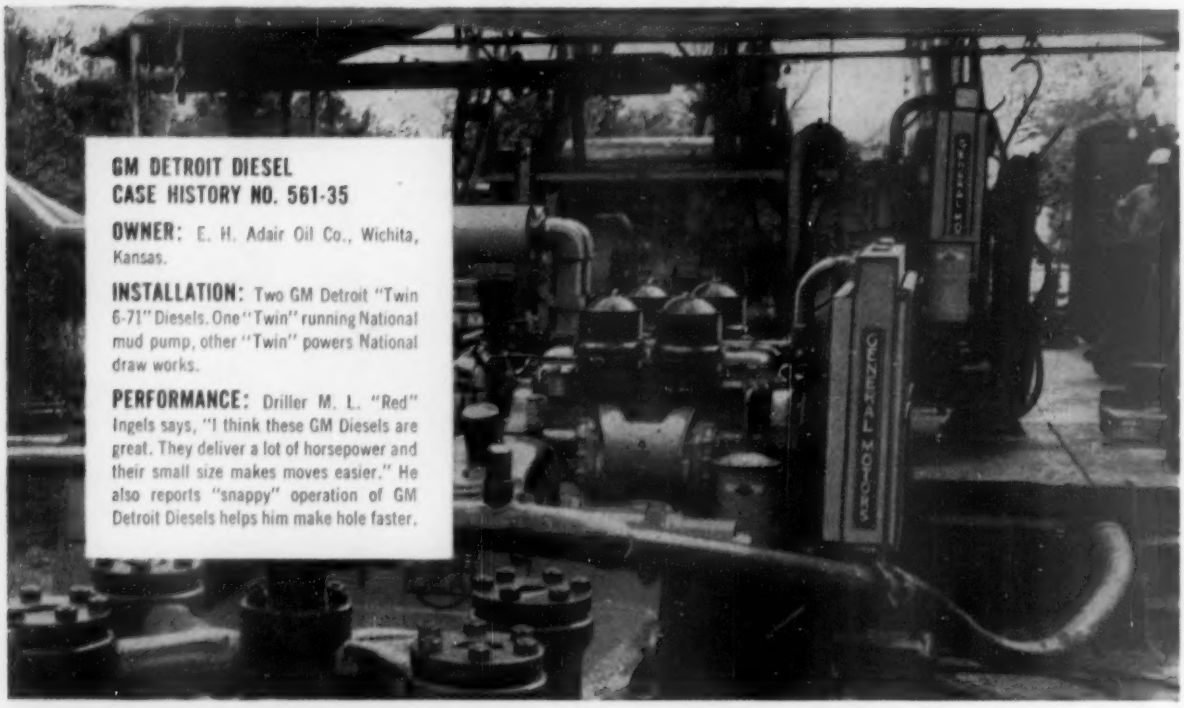

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exploratory interest east of Laverne in the Stockholm district.

Now the Harper County Pennsylvanian and Mississippian play is moving ahead at a fast clip with two new discoveries reported in the Laverne area last week; one in the upper Chester-Mississippian, the other in the Tonkawa-Pennsylvanian.

The upper Chester discovery is the first Mississippian production in this area. Cities Service Oil Co. 1 McClung-A, NW NW SE 11-26n-25w, flowed 6,000 M.c.f. of gas per day on test of the Mississippian at 6,945-50 and 6,958-66 ft. Location is in the new Northeast Laverne field, opened by Magnolia Petroleum Co. earlier this year. The 1 Stinson was a dual discovery with production from both the Morrow and Tonkawa sands. The Stinson strike flowed 12,000 M.c.f. of gas and 144 bbl. of distillate per day from the Morrow sand at 6,908-86 ft.; 22,000 M.c.f. of gas and 9 bbl. of distillate per million from the Tonkawa at 5,540-58 ft.

**. . . Tonkawa discovery.** Sunray has a Tonkawa discovery at 1 Hill in SE SE NW 6-25n-25w. This strike flowed 5,020 M.c.f. of gas per day with distillate. Perforations are at 5,634-76 ft. This well is 2 miles west of South Laverne field, a Morrow reservoir.

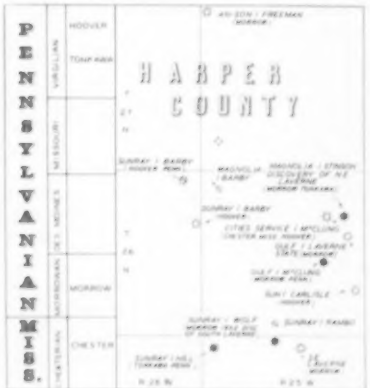
**. . . Laverne extended.** Gulf Oil Corp. extended the Morrow reservoir in Northeast Laverne district at 1 Laverne-State, SE NW 13-26n-25w. The well flowed 6,160 M.c.f. of gas per day from Morrow sand perforations at 6,918-7,035 ft. The gas and 14 bbl. mud-cut distillate with recovery including 80 ft. of clean distillate and 20 ft. distillate-cut mud.

Several weeks ago Sun Oil Co. 1 Carlisle in C SW NE 25-26n-25w, flowed 5,400 M.c.f. of gas daily on test of the Hoover-Penn sand at 4,145-4,211 ft. Gulf Oil Corp. 1 McClung, SE SE NW 23-26n-25w, southwest of the main portion of production in Northeast Laverne, flowed oil at the rate of 12 bbl. per hour on test of the Morrow sand at 6,927-7,002 ft.

**Hoover discovery . . .** An-Son Petroleum Corp. made calculated open flow tests at a wildcat at the north end of the play. The 1 Freeman, C NW NW 6-27n-25w, flowed 1,827 M.c.f. of gas per day with 14½ bbl. load per million on 9-hour test through ½-in. choke from Morrow perforations at 6,520-30 ft. Calculated open flow was 2,426 M.c.f. daily. The well is shut in pending outlet as are all the wells in this area.

**What's the outlook? . . .** A broad development program for the new Laverne area is expected on 640-acre spacing. The only blot on the bright picture for Laverne is the lack of outlet for the new gas. Ultimate recoveries in this region may run more than one million dollars per well on gas spacing.

The pay zones in the area range in depth from 4,200 to 6,800 ft. An-Son, Gulf, Sun, Sinclair, Sunray Mid-Conti-




**A fast-growing and apparently profitable pre-Permian play is developing in Harper County's Laverne district. Four townships are represented in this success story in northwestern Oklahoma. All wells shown are 1956 discoveries except the South Laverne and Southeast Laverne pools.**

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nent and others are active in the region.

Despite the outlet drawback, it appears that Harper County is headed for a position similar to that of Beaver County on the Pennsylvanian and Mississippian success stage in the Hugoton embayment.

### TEXAS PANHANDLE

## Morrow Sand Discovery Completed in Ochiltree

The south-central portion of Ochiltree County has a new Morrow sand oil producing area. The discovery well is M. A. Machris 44-141 P. A. Harbaugh, Section 141, Block 13, T&NO Survey, 22 miles south of Perryton town.

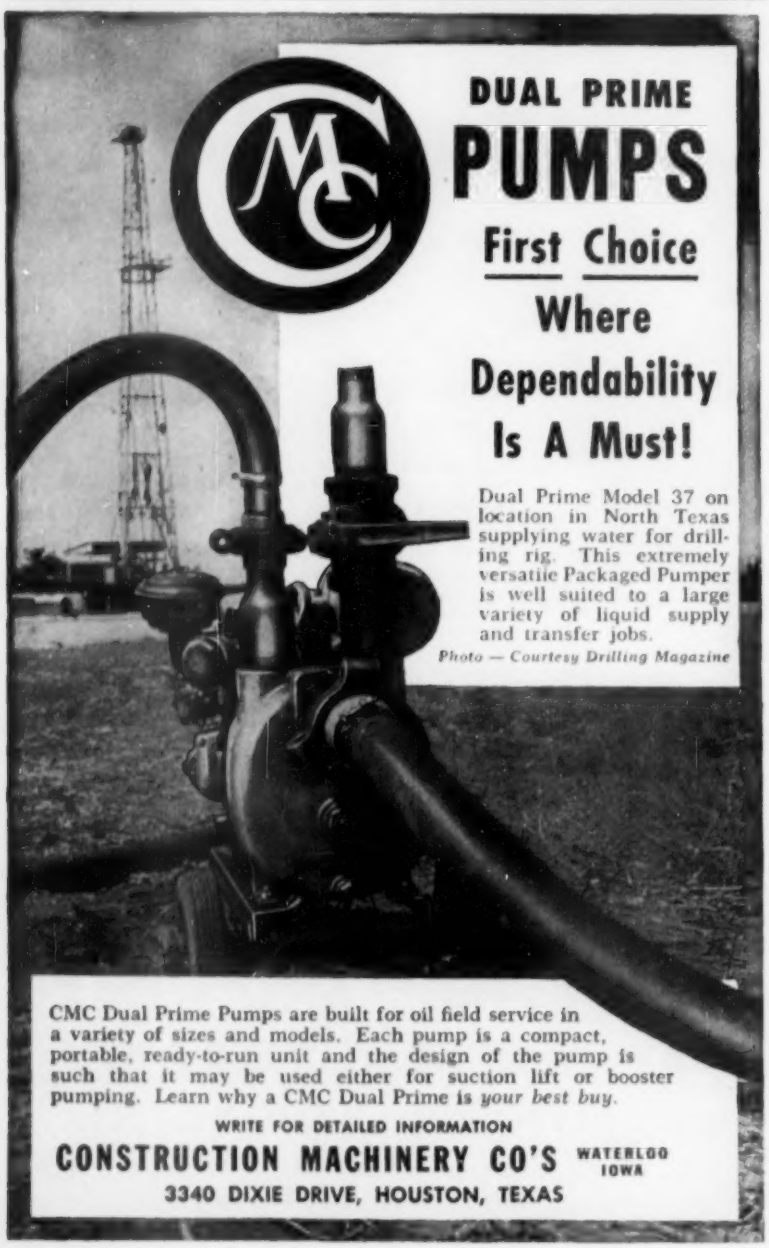
The new pool-opener flowed 245 bbl. of oil daily through perforations at 8,699-8,729 ft.

### OKLAHOMA PANHANDLE

## Testing Continues at Beaver County Discovery

The second zone in the Morrow sand is being tested at Stanolind Oil & Gas Co.'s 1 Campbell discovery in NW NW SE 5-2n-24eCM, Northwast Elmwood area, Beaver County.

The well flowed 253 M.c.f. of gas per day, natural, from perforations in the upper Morrow sand at 7,252-56 and 7,260-72 ft. Lower Morrow perforations at 7,606-16 ft. flowed 1,107 M.c.f. daily on open flow test. The northeast offset to the discovery is under way at 1 Miller in NW NW SE 33-3n-24eCM.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# WESTERN CANADA

### MANITOBA

## 58-Well Drilling Program Announced

Gridoil Freehold Leases, Ltd., Calgary, announced an operating agreement which includes Standard of California, Canadian Gulf, and Imperial Oil, Ltd., among others, to explore central Manitoba.

Each company will drill the number of wells proportionate to its acreage in the area. A total of 58 wells will go down in south-central Manitoba. Gridoil has 153,070 acres throughout most of the area, comprised of 100 separate parcels. They will drill three wells in the area. Total area developed in the drilling program is 3,500,000 acres. No well will be drilled closer than 3 miles from any other well.

### ALBERTA

Canadian Bishop Oil, Ltd., wholly owned subsidary of Bishop Oil Co., announced that two additional wells have been spudded on its most recent 640-acre acquisition in Pembina oil field of Alberta Province, Canada.

Canadian Bishop 12-16 on the company's "F" lease of 320 acres is drilling ahead at 1,770 ft., whipstocking under the North Saskatchewan River from an on-shore location approximately 50 ft. from the company's 14-16 well. The latter has been drilled to a total depth of 5,020 ft. and 7-in. casing cemented to 4,971 ft. in preparation for production test. When completed, well 12-16 will be bottomed approximately 1,500 ft. to the southwest.

Canadian Bishop also has spudded well 6-3 on its 320-acre "E" lease. This well is down 70 ft.

Awaiting production test on the "F" lease is Canadian Bishop 10-16, which was drilled to 4,999 ft. with 7-in. casing cemented at 4,952 ft. Wells 10-16 and 14-16 were spudded in March, their drilling and completion having been delayed by impassable road conditions in the field. Company officials said the road situation has now been cleared up.

## Calgary Area Has Crossfield Discovery

An interesting wildcat well just 4½ miles east of Calgary in the Chester-

mere Lake area, Mobil Oil 18-11, Chestermere, on LSD 11, 18-24-20w4, has given a good flow of natural gas in the Crossfield section of Devonian during initial stages of testing prior to actual production tests. Natural gas was measured at a rate of 2,760 M.c.f. daily through a 12/64-in. choke following two acid treatments of the D1. The well now has been completed as a Crossfield gas well.

The intervals of 8,442 to 8,512 ft. and 8,522 to 8,562 ft. were perforated with two jet shots and two bullets per foot. The open zone was first treated with 2,500 gal. and then 7,500 gal. of acid. The D1 of Devonian was topped at the 8,216-ft. mark. Seven-inch production casing was landed at 8,585 ft. and the well was plugged back from total depth of 8,587 ft. to 8,571 ft.

### Gas Discovery Recorded at Consort

Tennessee Gas Transmission Company reported that its Crown B-1 wildcat test in the Consort area of southeastern Alberta yielded gas in sufficient volume to warrant setting of production casing for valuation tests. This Viking sand strike is now suspended.

The well, T.G.T. B-1 Crown is on LSD 11, 20-36-7w4, which is 4 miles west of the previously proved limits of the Provost-Consort Viking sand gas field.

Crown B-1 topped the Viking sand horizon at 2,662 ft. and the gas pay zone contact was 2,680 ft. (K.B. elevation 2,514 ft.) Initial drill-stem test in the Viking of the interval 2,671 to 2,746 ft. gave a good initial puff with gas to surface immediately at 362,000 cu. ft. daily. Gas flow increased to 627,000 cu. ft. daily before packer unseated in 15 minutes. The test was classed as a misrun.

Second test of the interval 2,668 to 2,746 ft., with valve open 48 minutes and shut in 30 minutes, gave a good initial puff. Gas rose to the surface immediately at 325,000 cu. ft. daily with the flow increasing to 931,000 cu. ft. daily.

## PACIFIC COAST

#### CALIFORNIA

### Two Discoveries For Hollister Area

Harry H. Magee chalked up two interesting discoveries, one oil and the other gas, in the Hollister area of San Benito County. Both resulted from redrilling previously abandoned wells.

The oil discovery was 1 Breen, located SW NE 19-12s-5e. This test was


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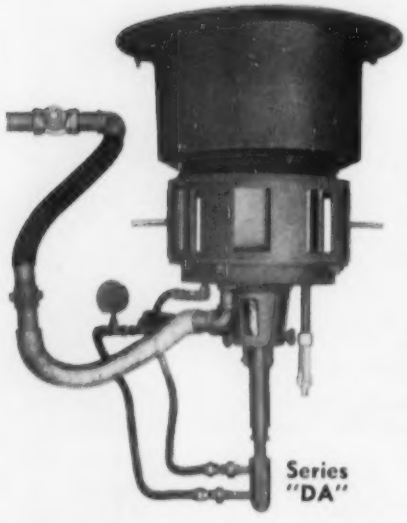


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originally drilled and abandoned in 1953 by Tidewater Oil Co. Magee, acting as operator for himself and Trico Oil & Gas Co., set a whipstock and redrilled the abandoned well to 4,000 ft. On a production test of the Franciscan zone found in the well at the interval 3,969-4,000 ft., the well flowed at a 250 bbl. daily rate of 30°-gravity crude. It has been shut in pending installation of production equipment and tanks. This well site is in the Flint Hills region, about 3 miles northwest of the town of Hollister.

The gas discovery, which opened a new zone in the northwest Hollister area, was 1 O'Connell. Magee took over the wildcat, which was abandoned by The Texas Co. in 1951, and set a whipstock and redrilled to 1,019 ft. It was gun perforated between 990-1,015 ft. Initial gas production through a ¾-in. choke was 2,000 M.c.f. daily. This well is about 2½ miles southeast of Lomerias field discovery in 1950.

## Union Extends Stevens Production at Strand

Union Oil Co. has extended Stevens zone production in Strand field more than 1 mile north of Shell Oil Co.'s discoveries in this Kern County field. Union was preparing to install a pump on the 10,163 ft. 73-2 Smith following an earlier test which flowed 500 bbl. daily on a short gage. However, the well failed to flow on subsequent tests and when the fluid level dropped to 6,300 ft., Union decided to move in the pumping unit.

This test, which was plugged back to 9,810 for the completion try, is located SE NE 2-30s-25e.

## Union, Texaco Prove Up Production in Bridge Pool

Union Oil Co. and The Texas Co., with Texaco acting as operator, recently brought in a pair of prolific producers in the newly discovered Bridge Pool of South Mountain field in Ventura County. This area, with only 3 wells completed in it, is credited with being one of the biggest finds of the year in California.

May 8, Texaco completed 2 Texas-Union-Richardson-Earl, as eastern offset to the discovery, for initial production of 925 bbl. daily of 31.5°-gravity crude. The next day the operator brought in 1 Texas-Union-Hyde-Pinkerton, a northern offset to the pool discovery, for 821 bbl. daily of similar gravity oil.

The producing intervals of both wells are in the Pico sands of Pliocene age while production from neighboring South Mountain field is from Sespe

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*Photo courtesy Chemical Process Co.*

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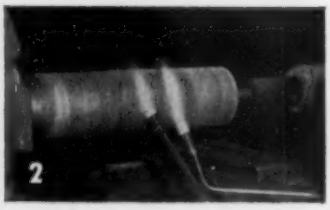


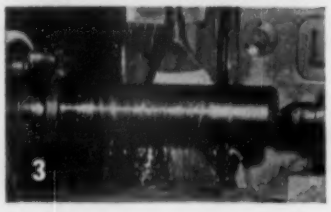


**1** Plunger is prepared for Spraywelding by undercutting and grit blasting. Using the Colmonoy Spraywelder, powdered Colmonoy alloy is sprayed on the turning part.

**2** The Colmonoy surface is then heated to about 1900°F. to create a welded bond between overlay and base metal.

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formations. The perforated zones of the 8,319 ft. 2 Richardson-Earl area 6,338-7,016 ft. and 7,375-8,050 ft. The perforations in the 8,511 ft. 1 HydePinkerton well are between 6,497-8,100 ft.

The pool area is just across the Santa Clara river from Santa Paula.

## GREAT LAKES

### MICHIGAN

First reports following a 4,000-gal. acid treatment to a Salina oil showing pay were encouraging from the Louis Zellman 1 Helmer, SE NE NW 25-4n-13w, first test well in this horizon in Dorr pool, Salem Township, Allegan County.

The 1 Helmer was reported to have swabbed and flowed 66 bbl. of net green oil first 8 hours following completion of acid treatment. Pay was drilled between 2,746-64 ft. Hole carried about 3 bailers of free oil natural after 5-in. casing was cemented at 2,755 ft.

Meanwhile, new Ottawa County Dundee-Monroe oil showing wildcat was reported to be pumping between 10 and 12 bbl. of oil a day natural from 2,110 ft., total depth. This new well is the Miller Brothers 1 Siemion, NE SE SW 3-7n-15w, Robinson Township, Ottawa County, first well in the county to show for possible commercial completion as an oil well below the Traverse.

## ROCKY MOUNTAIN

### UTAH

### Another Big Well Added to Aneth Field

San Juan County's prolific new discovery area, Aneth, received another big well last week. The Texas Co. completed the 1 Navajo "E" in NW SE SE 15-40s-24e, flowing at the rate of 966 bbl. of oil per day from the Paradox-Pennsylvanian. This is Texaco's third well in the field. The discovery well at Aneth made 1,704 bbl. per day; another well 1,800 bbl. The offset well to the discovery, a Superior well, finaled for 615 bbl. per day. Location is in the Baradox basin.

### Confirmation Staked to Joe's Valley Discovery

San Pete County's Joe's Valley area discovery has a 8,100-ft. confirmation well in store at Three States Natural

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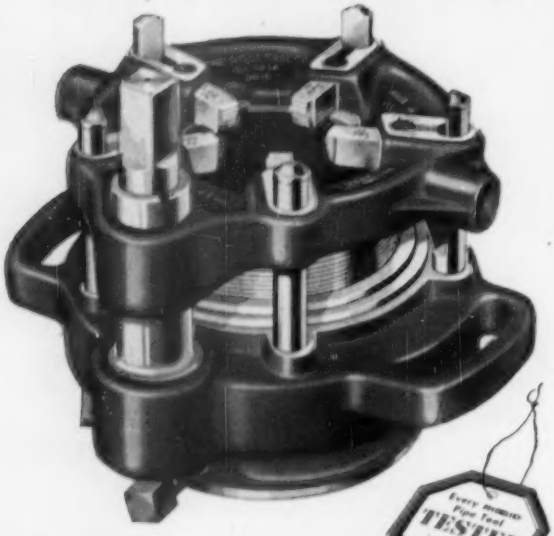

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Gas Co. 3 Joe's Valley, SW NW 20-15s-6e.

The Joe's Valley area was opened last year at the 1-X Joe's Valley, NW SW NW 17-15s-6e. The Ferron sand discovery flowed 15,000 M.c.f. of gas per day. Not all the Ferron section was drilled and operators think more gas pay will be found. The confirmation attempt will drill into deeper zones than did the discovery well which was shut in due to winter conditions last fall. The new well is 1 mile southeast of the discovery well.

### MONTANA

## Wolf Springs Now Has Seven Producers

The seventh oil well in Wolf Springs, Yellowstone County, has been completed. It is Atlantic Refining Co.'s 13-1 Horton estate in C SE SE 13-7n-31e.

Initial flow was 672 bbl. per day on ¼-in. choke from Amsden perforations at 6,124-6,510 ft. Location is ½ miles north of DeKalb's 1 State, a 785-bbl. per day well on ¾-in. choke.

The field remains one of the most active areas in Montana with five rigs seeking pay. Carter Oil Co. is active with three rigs; Atlantic has 2. Carter's refinery at Billings is taking the field's production at the rate of 100 bbl. per day per well.

### NORTH DAKOTA

## Coteau Field Confirmation Well Is Abandoned

Calvert Drilling Co. has quit at the confirmation to Coteau field in Burke County, one of the exploratory highlights of 1955. The 1 Jepson in NE NE 30-161n-90w, went to 7,280 ft. There were no shows on four drill-stem tests at the well. The discovery well, 1 Opseth, C NE NW 28-161n-90w, made 40 bbl. of oil per day, sparking hopes for a big play in the area between the Nesson anticline and the Williston basin's northeast edge.

## Phillips Completed Divide County Discovery

The Divide County discovery well, 1 Braathen, has been completed by Phillips Petroleum Co. and R. M. Ballard. Location of the 36-bbl. per day pumper is NE NW 29-162n-95w. Production is from Madison at 7,076-92 ft.

The strike opens first production in the county. It lies 20 miles north of Nesson anticline field production. No additional development in the area has been reported to date.

## SOUTHEASTERN STATES

### MISSISSIPPI

## Rodney Island Production Spreads Into Mississippi

Louisiana's Rodney Island field was extended last week across the Mississippi River into Jefferson County, Mississippi, giving the latter state another Tuscaloosa producing area.

The extension well, located in the northwest corner of the county, was directionally drilled from a surface location on the bank of the Mississippi River to bottom location under the river bed.

The well, 1 Wood, drilled by Midstates Oil Corp. and G. H. Jett, was completed with a flow of 155 bbl. of 38.9°-gravity oil per day through ⅛-in. choke with pressure of 1,675 psi. Its pay, in the Tuscaloosa Massive zone, is perforated at 9,292-96 ft. It was drilled to 9,380 ft. (vertical depth 9,337 ft.)

The Louisiana portion of the field, on Rodney Island, in the southeastern corner of Tensas Parish, was opened by Jett Drilling Co. and associates last year. It now has 10 producing wells, all completed in the Tuscaloosa section.


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## SOUTH LOUISIANA

### New Oil Producer Indicates Amelia-Lake Palourde Link

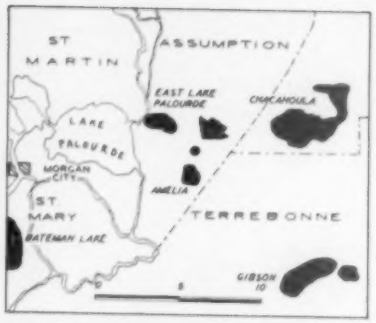
Union Oil Co. of California is providing a possible link in connecting Amelia and East Lake Palourde fields, in southern Assumption Parish.

Its 1 Aristile Landry, 3,200 ft. north of the nearest well at Amelia, and 9,000 ft. southeast of East Lake Palourde production, is proving productive of oil from a 12,600-ft. sand.

Production is rated good for 390 bbl. of 36°-gravity oil, flowing through 9/64-in. choke. Flow was under pressure of 3,450 psi. with gas-oil ratio of 2,194 cu. ft. per barrel. Pay is perforated at 12,666-73 ft.

As an extension of the Amelia area, it not only opens a new sand but also the area's first oil production. Previous production, from sands below 14,000 ft., has been gas and condensate.

Amelia was opened by M. L. Mayfield in December 1953. Three gas-condensate wells have been completed, two (including discovery well) by Mayfield, and the third, added last February, by Atlantic Refining Co. The latter, nearest to Union's new oil discovery, is ¾ mile north of Mayfield's two wells.




**Portion of southern Assumption Parish showing location (indicated by arrow) of Union Lake Palourde fields. The general area is from 8 to 10 miles northeast of Morgan City.**

East Lake Palourde field, which Union opened in April 1954, has 18 wells with both oil and gas and condensate production from multiple sands from 12,500 ft. to 13,400 ft. In addition to Union, California Co., Humble Oil & Refining Co., and Superior Oil Co. have production in the field.

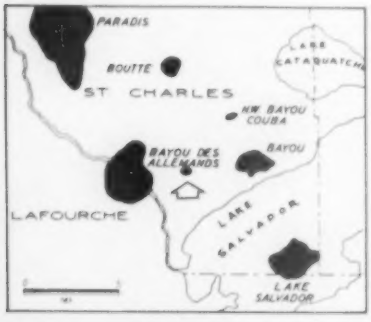
### St. Charles Oil Discovery Opens New Producing Area

A new oil-productive area with pay at a relatively shallow depth is being opened in southern St. Charles Parish, about 20 miles southwest of New Orleans.

Discovery well, 2-A Waterford, drilled by John W. Mecom and Freeport Sulphur Co., flowed 107 bbl. of 28°-gravity oil per day during preliminary tests through ¼-in. choke. Its pay is perforated at 5,352-56 ft.

Hole was drilled to 12,029 ft. and hasing to 11,121 ft. Completion in the 5,300-ft. sand follows a series of successful tests in several deeper zones.

Location is about midway between Bayou Des Allemands and Bayou Couba fields, about 2½ miles from each. The former, discovered in 1937, produces from a multiplicity of sands




**Location (arrow) of John W. Mecom's and Freeport Sulphur Co.'s new oil-discovery well in southern St. Charles Parish.**


ARCCO

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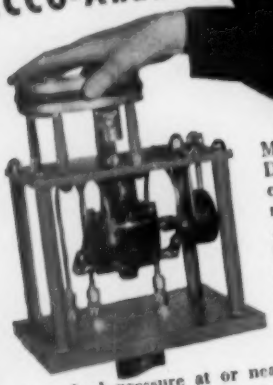

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ranging in depth from 3,750 to 10,400 ft. Bayou Couba, opened in 1942, also produces from many sands with a depth range of 2,642 to 10,500 ft.

## Deep Abbeville Wildcat Tests Gas and Distillate

Gas-Condensate production has been tested by Richardson & Bass in a deep wildcat a mile of the old Abbeville field, in northern Vermilion Parish..

The wildcat is their 1 Amerada-Maxie Broussard and others, in 8-12s-3e. It was drilled to 16,250 ft. as one of the deepest tests in the parish. Hole is cased to 16,000 ft.

Production is from a zone at 11,920-24 ft. Tested through 7/64-in. choke, flow was 56 bbl. of 50.4°-gravity condensate and 1,909,000 cu. ft. of gas per day. Pressure was 8,400 psi. on the tubing.

Abbeville field, discovered by Continental Oil Co. in March 1937, is productive of oil or gas and condensate from a multiplicity of sands from 6,250 ft. to below 11,550 ft.

### LOUISIANA OFFSHORE

## Deeper Pay Produces In New South Pass Field

Humble Oil & Refining Co.'s second well in its recently discovered South Pass Block 20 field in the Gulf of Mexico off the tip of Plaquemines Parish, is being completed in a sand more than 2,000 ft. below that of the discovery well.

The new well, 2-A State Lease 2716, produced at the rate of 12.25 bbl. of 65°-gravity condensate with 957,000 cu. ft. of gas per day during a preliminary test through ⅛-in. choke. Its pay is perforated at 11,561-70 ft. Total depth is 12,800 ft., with casing on bottom.

Humble's discovery well, completed last March, is a dry gasser with pay perforated at 9,521-34 ft. It has been shut in ungaged since completion.

# SOUTH TEXAS

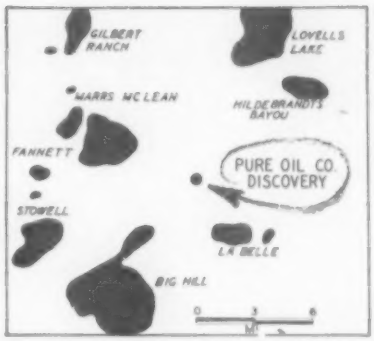
### GULF COAST

## Jefferson County Gets Gas-Distillate Discovery

Pure Oil Co. has an indicated new-field discovery 8 miles southeast of Fannett, in Jefferson County, where its 1 Ward, a wildcat nearly 3 miles from nearest production, flowed gas and condensate in a preliminary drill-stem test of a casing-perforated interval at 8,672-94 ft.

Tester was open 30 minutes with ¼-in. and ⅛-in. chokes. No gage was made, but pressure was 3,225 psi. Flow unloaded 3,000 ft. of water cushion.

Location is northwest of LaBelle field, nearest production, and about 3½ miles southeast of Fannett field.




**Arrow points to location of Pure Oil Co.'s indicated gas-condensate discovery well in Jefferson County, southeastern Texas.**

## Gasser Opens Bee Field

Potential production of the new gas-discovery well completed by W. B. Cleary, Inc., and James H. Heeland southeast of Beeville, in Bee County, is placed at 15,000,000 cu. ft. per day. Flow during potential test was under pressure of 1,460 psi. Gas, from Pettus sand at 3,476-82 ft. is dry.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SOUTHWEST TEXAS

## LaSalle County Wildcat Opens New Olmos Field

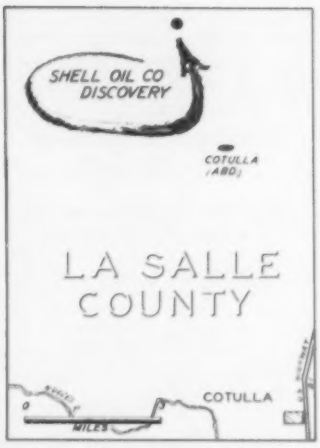
A rank wildcat test drilled by Shell Oil Co. in northwestern LaSalle County, has been completed as a new Olmos-sand oil-discovery well.

It is Shell's 1 Mathews, in Block 4, I&GN Survey 2, about 11 miles northwest of Cotulla. The discovery has been designated as Woodward field, after a small, inland townsite.

Completion flow was 67.05 bbl. of 37.7°-gravity oil per day, net recovery, with total flow cutting 48 per cent water. Flow was gaged through 3/16-in. choke with pressure of 220 psi. and gas-oil ratio of 614 cu. ft. per barrel.

Pay is perforated at 5,008-15 ft. with casing cemented at 5,195 ft. in hole drilled to 10,742 ft.

Location is more than 20 miles from nearest current production, located to the north in southwestern Frio County and southeastern Zavala County. It is more than 3 miles northwest of abandoned one-well Cotulla field. The latter field's discovery, and only producer was drilled by Henderson Co-quat and O. R. Mitchell in 1951. It was completed in the much-younger Eocene-Carrizo sand at 2,214-18 ft. after drilling to 5,757 ft. The well was abandoned in 1953 with accumulated production of 3,792 bbl.




**Shell Oil Co.'s new Olmos oil-discovery well (indicated by arrow) 11 miles northwest of Cottula, in norwestern LaSalle County.**

## Successful Wildcats

### ALBERTA

T.G.T. B-1 Crown, LSD 11, 20-36-7w4. TD 2,753 ft. Indicated Viking gas well.

Mobil Oil 18-11 Chestermere, LSD 11, 18-24-20w4. TD 8,587 ft. Crossfield gas well.

### NEBRASKA

Morrill County: Skelly Oil Co. 1 Lindberg, NW NW SW 11-17n-52w. IPP 330 BOPD, "J" sand discovery, new field. TD 5,262 ft. "J" sand.

### NORTH DAKOTA

Divide County: Phillips Petroleum Co. and R. M. Ballard 1 Braathen, NE NW 29-162n-95w. IPP 36 BOPD, Madison discovery, new field. TD 7,361 ft. Madison.

### KANSAS

Decatur County: Cities Service Oil Co. 1 Warner, NE NE SW 11-1s-27w. IPP 330 BOPD, Lansing-Kansas City Pennsylvanian discovery, new field. TD 3,530 ft. Granite wash.

### CALIFORNIA

Sacramento County: The Texas Co. 2 Arthur Brown, NE NW 11-4n-4e, IP 2,000 M.c.f. daily, 16/64-in. choke, perfs. 3,170-3,230 ft., TD 4,750. Plugged back to 3,314 ft. (New gas pool discovery in the Georgiana Slough area of River Island field.)

San Benito County: Harry H. Magee and Trico Oil & Gas Co. 1 Breen, SW NE 19-12s-5e, BOPD 250, 30° gravity, ¾-in. choke, perfs. 3,804-4,000 ft., TD 4,591 ft. (New pool discovery in Hollister area.)

San Benito County: Harry H. Magee 1 O'Connell, NE SE 14-12s-4e, IP 2,000 M.c.f. gas daily, ¾-in. choke. perfs. 990-1,015 ft., TD 1,019 ft. (New Pliocene zone gas discovery 2½ miles southeast of Lomerias field.)

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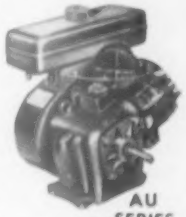

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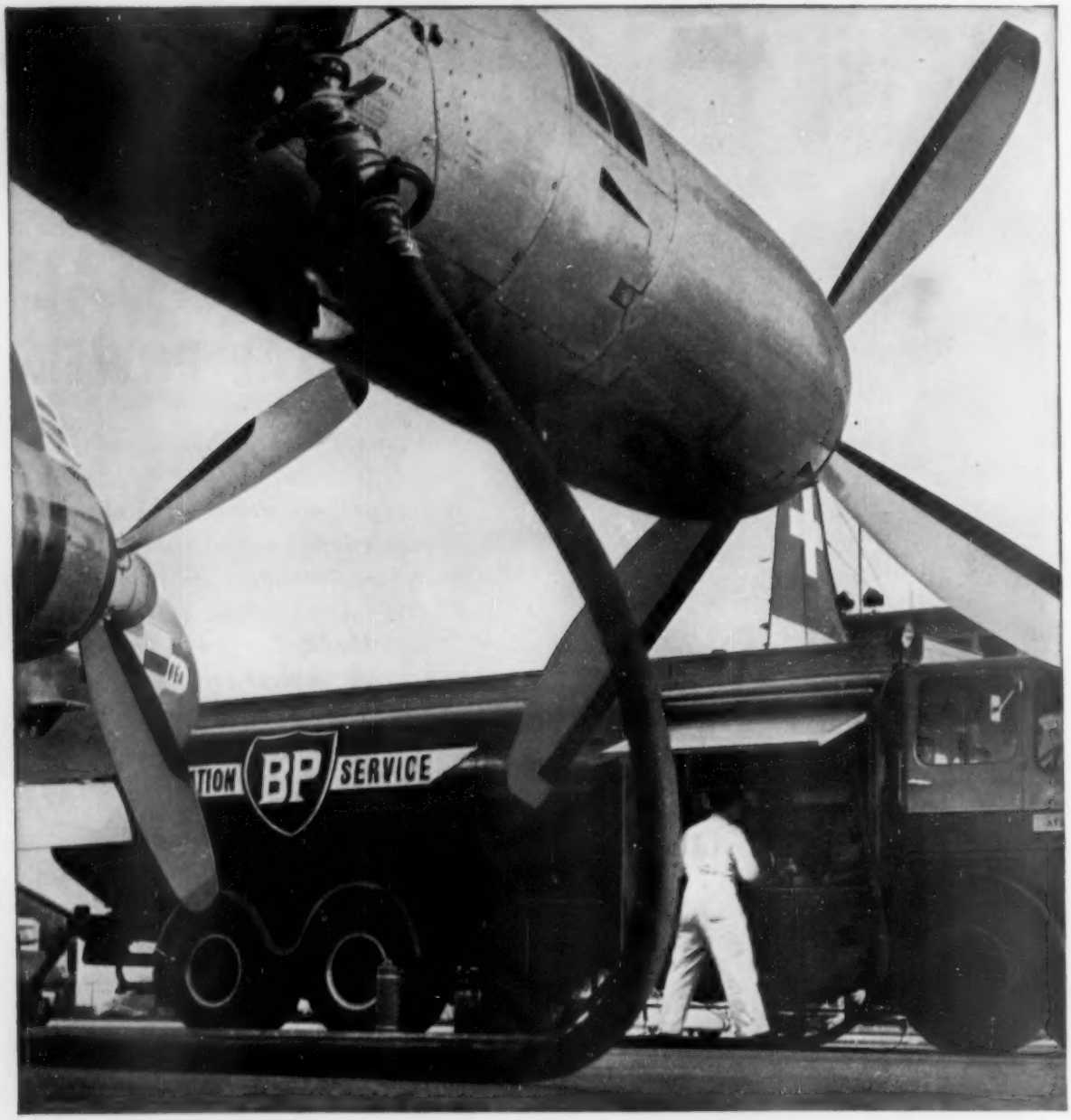


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# Davis Given High Humble Post



A "ROCK HOUND'S rock hound" moves this week into the newly created post of executive vice president of Humble Oil & Refining Co.

That's the description fellow geologists give to Morgan J. Davis, who has spent most of his professional career hunting oil for Humble. His new job, as outlined by President Hines H. Baker, is to "share the load of general executive work and assist the president in general administration of the company's affairs."

Morgan Davis is one of the country's best-known geologists, but he is no stranger to executive work. He worked his way up through a series of managerial posts and has been a director and a vice president of Humble for several years.

**Native Texan . . .** Davis, an easygoing, lanky Texan (Anson, 1898) is a rock hound by training, experience, and hobby. With the exception of a 5-year stint in the East Indies, he's spent his entire professional career with Humble.

He received his B.A. in geology from Texas U. in 1925, having previously attended T.C.U. for 2 years. His first assignment was as geologist in the old Cisco Division in June of that year.

A few months later he went to Roswell, N. M., and remained there for 4 years before departing for service with Nederlandsche Koloniale Petroleum Mij. He was stationed in Java and Sumatra and led geological expeditions into several islands of the archipelago.

When Davis was returned to Humble in 1934 he had had enough of tropical climates. Given a choice of locations, he picked Roswell over the Gulf Coast. But 2 years later he was made Gulf Coast division geologist.

He rose to chief geologist for Humble in 1941, and when the geologic, lease and scouting departments were combined into the exploration department in 1946, he was made manager of that as well. In May 1948 he became a member of the board of directors and in May 1951 was named a vice president.

Davis stresses that Humble's exploration has been a team effort—one which, incidentally, has seen Humble's production jump from 49,000 bbl. daily in 1925 to 357,000 bbl. in 1955.

**Man of activities . . .** His professional colleagues honored him by electing him president of A.A.P.G. in 1952-53. He is also a member of A.P.I.'s reserves committee, a member of advisory council of geology foundation of Texas U., and a member of the alumni advisory committee on advanced management program at Harvard Business School.

In addition he includes A.I.M.E., Texas Academy of Science, Geological Society of America, Houston Geological Society, and American Geophysical Union among his many memberships. He is also a member of Sigma Gamma Epsilon, honorary mineral science fraternity.

He's a flier by hobby and owned a light plane for several years. You get more bounce to the ounce flying a puddle jumper instead of taking a commercial airline, he avers. Lack of time intruded on this hobby and he sold the plane but still retains his private license in force. Hunting is his chief recreation these days.

Although his new duties will take him away from geology on a professional scale to some extent, he maintains geology as a major interest. Aside from commercial and utilitarian purposes, he has found geology stimulating and has a real interest in its problems.

To the young man on his way up, Davis makes these points: There's no difference in the qualities and abilities needed today than in 1925. Hard work, careful attention to duties, and even some late hours is what it takes to do the job and get ahead. There are probably more opportunities today than before, and all one has to do is have at it.

Would he recommend geology as a career for young men today? His answer is to point to his two sons, Morgan, Jr., who has a master's in geology and is now with International Petroleum Co. in South America, and Jim, who's getting his bachelor's degree in geology at Washington and Lee University.

**A. C. Austin,** geophysical supervisor for Ohio Oil Co., has been transferred from Tulsa to Casper, Wyo.

**Carey J. Wooley, Jr.,** has been transferred by Humble Oil & Refining Co. from supervising petroleum engineer in Houston to district supervising petroleum engineer in Kingsville, Tex.

**Frank E. Hogdon,** for several months assistant director of the American Gas Association Laboratories, has been named director.

**Fred Ferguson** has been advanced by Ohio Oil Co. from process engineer in Houston to gas engineer in Findlay, Ohio.

**James E. Berry** and **Warren G. Hicks** have been promoted to senior research technologists in Magnolia Petroleum Co.'s Dallas field research laboratories. Berry a research geophysicist, does log interpretation. Hicks is a research engineer studying application and evaluation of continuous velocity logging in exploration and production.

**William L. Stubblefield,** Skelly Oil Co. production engineer, has been transferred from Carmi, Ill., to Bay City, Tex.

**Dr. J. M. Lebeaux,** formerly with Stanolind Oil & Gas Co., has been named research and development engineer at Oil Center Tool Co., Houston. Lebeaux earlier was assistant professor of petroleum engineering at the University of Texas.

**John C. Moulton** has resigned as geologist for Humble Oil & Refining Co. in Midland, Tex., to become a consultant there.

**C. A. Hutchinson, Jr.,** former senior reservoir engineer in Atlantic Refining Co.'s research and development laboratory, Dallas, has been named to supervise the reservoir-mechanics group there. **William M. Campbell,** who has been with the well-logging group, replaces Hutchinson. **W. W. Scott** was promoted from operating coordinator to senior production engineer in Atlantic's petroleum-engineering group.

## Personals

**William M. Erdahl,** Skelly Oil Co., has been elected president of the Geophysical Society of Tulsa. Other new officers: **John J. Rupnik,** of Rupnick & Ballou, first vice president; **James J. Johnson,** Sinclair Oil & Gas Co., second vice president; **Ralph D. Lynn,** Carter Oil Co., secretary; **John E. Bondurant,** Phillips Petroleum Co., treasurer; and **V. L. Jones,** consultant, editor.

**R. R. McDaniel** has been promoted by Southern Pacific Pipe Lines, Inc., from eastern district field superintendent, El Paso, to superintendent of the northern district, San Francisco. **J. R. Davis** succeeds McDaniel. **C. B. Miller** has been named assistant to the general manager in S-P's Los Angeles headquarters.

**Guy W. Duren,** former superintendent of Cities Service Oil Co.'s West Seminole, Tex., gasoline plant, has been transferred to Bartlesville, Okla., as senior process engineer, natural gasoline division. **Edgar B. Lord** moves up from maintenance superintendent to succeed Duren at West Seminole.

**F. O. Koontz,** vice president of Quaker State Oil Refining Corp., since 1952, has been elected to the newly created post of executive vice president. Elected vice presidents were **Dr. C. W. Georgi,** research director; **J. P. Healy,** manager of oil properties and pipelines; and **E. E. Ebner,** general superintendent of refineries. All are directors of the Oil City, Pa., firm.

**W. E. Powell,** land and exploration vice president of Husky Oil & Refining Co., has been named vice president of exploration and production. He succeeds the late J. F. Paterson.

**F. T. Lloyd,** Richfield Oil Corp., has been elected 1956-57 chairman of the Pacific Coast district of the American Petroleum Institute's Division of Production. Vice chairmen elected: **Henry G. Adabie,** Long Beach Oil Development Co., Los Angeles basin; **I. M. MacKenzie, Jr.,** General Petroleum Corp., coastal; **H. D. Campbell,** Franco-Western Oil Co., San Joaquin Valley; and **O. M. Griffin,** Sunray Mid-Continent Oil Co., Coalinga-Kettleman. Other new officers: **Charles T. Reichert,** National Supply Co., treasurer; **Mrs. Elsie M. Edmiston,** A.P.I., secretary; **John Bell,** Humble Oil & Refining Co., advisory committee chairman; and **Paul Andrews,** Signal Oil & Gas Co., advisory committee vice chairman.

### A.P.I. Eastern Production Men Elect New Officers

**The eastern district of the American Petroleum Institute's Division of Production elected new officers at its recent spring meeting in Columbus, Ohio. Shown left to right, front, are: Dean Russell, Gordon Drilling Co., Mt. Pleasant, Mich.; Millard Flood, Ohio Oil Co., Terre Haute, Ind.; Wendell Moore, Columbian Carbon Co., Charleston, W. Va., all district vice chairmen; and H. J. Magner, Delta Drilling Co., Pittsburgh, secretary-treasurer. Left to right, rear, are: J. Robert Hornor, Delaware Gas Co., Charleston; Lysle Kirk, Ohio Fuel Gas Co., Columbus; and John C. Hall, Standard Oil Co. (Ohio), Evansville, Ind. All are vice chairmen. The new district chairman, Douglas Rogers, Jr., of South Penn Oil Co., Bradford, Pa., is not shown.**

**Dallas E. Hawkins, II,** assistant to Sun Oil Co.'s Canadian division operations superintendent since 1953, has resigned to join Fargo Oils, Ltd., Calgary, as general manager. Before joining Sun, Hawkins was operations superintendent of Canadian Delhi Oil, Ltd., Calgary.

**Grier Zimmerman,** former tool pusher and drilling engineer for Kerr-McGee Oil Industries, Inc., has been promoted to the new post of drilling operations supervisor on the Gulf Coast. Other changes in Kermac's Gulf Coast operations: **W. C. (Carl) Larson,** from tool pusher to Central Gulf division drilling superintendent; and **Kenneth W. Parker,** from tool pusher and engineer in the gulf region to Oklahoma City as special assistant to the general manager of drilling and production.

**James H. Anderson,** formerly with Mississippi River Fuel Corp., St. Louis, has been named manager of gas project development for Southwest Gas Producing Co., Monroe, La. He'll head a new office in Shreveport.

**Robert H. Lyddan** has been named assistant director of the U. S. Geological Survey, Washington. He has been regional engineer in the Atlantic regional office's topographic division, Arlington, Va., since 1955. Earlier he was chief of that division's plans and coordination branch.

**Gayle A. Oglesby** has resigned as geologist for Ohio Oil Co. in Midland, Tex., to join Reynolds Metals Corp.'s oil and gas division as district geologist in Fort Smith, Ark. Before joining Ohio early in 1955, Oglesby spent 3 years as assistant to the Arkansas state geologist.

**Robert S. Ray,** manufacturing manager, and **Jack Tielrooy,** development manager of Brea Chemicals, Inc., have been named vice presidents of the Union Oil Co. subsidiary.

**Harley N. Reavis** has been promoted from supervising petroleum engineer to assistant division engineer in Humble Oil & Refining Co.'s North Texas division. Reavis replaces **C. W. Armstrong, Jr.,** promoted in March to assistant superintendent of the Winters district. Other Humble production changes: **R. G. Tonkin,** from supervising petroleum engineer in the Stratton district, Southwest Texas division, to assistant district superintendent in Hobbs, N. M., western division; **C. J. Wooley, Jr.,** supervising petroleum engineer, from Houston to the Stratton district; **V. R. Sage,** from associate petroleum engineer to petroleum engineer in the Government Wells district, Southwest Texas division; and **S. L. Kennedy, Jr.** from junior petroleum engineer to associate petroleum engineer in the Kelsey district, Southwest Texas division.

**Warren Perry,** superintendent of Loffland Brothers Co.'s Oklahoma division since 1947, has been promoted to operations manager. **Charles D. Brown** succeeds Perry.

G. J. SMITH

**G. J. Smith,** formerly with Pan American Production Co., Houston, has been named foreign exploration superintendent of Stanolind Oil & Gas Co. He succeeds **T. H. Hendricks,** named consulting engineer after recovering from a recent illness. Smith will supervise Stanolind's Cuban and Jamaican ventures. The move stems from the absorption of Pan American by Stanolind, one of several consolidations recently announced by the parent Standard Oil Co. (Ind.).

**Frank Manning,** Pure Oil Co. production superintendent, has been transferred from Edmonton to Grand Junction, Colo.

**M. D. Voss,** assistant manager of the reservoir division in Phillips Petroleum Co.'s economics department since last December, has been promoted to manager. He succeeds **C. E. Turner,** recently promoted to economics department manager.

**Wayne Granger** and **Bill Henkel** have resigned as executive vice president and landman, respectively, of Columbine Exploration Co. to open independent offices in Denver.

**Edmund E. McCurtain** has been promoted to district engineer in British-American Oil Producing Co.'s southern district, Houston. He has been acting district engineer there since January.

**R. V. Provine,** formerly chief chemist for D-X Sunray Oil Co., has been promoted to director of a new chemical research section at the firm's West Tulsa research laboratories. Recent reorganization at the lab created three other new sections. Quality control will be headed by **C. Prather,** former head of the antiknock lab; chemical engineering will be under **V. L. Brandt;** and technical sales service will be directed by **J. V. Lawson,** formerly head of the product and process group. **W. L. Thompson,** D-X Sunray research and technical service division manager, will supervise work of all the new sections. The company recently announced plans to double the size of its research lab.

**T. C. Williams** has been promoted by Honolulu Oil Corp. from district engineer to district superintendent in Wasson, Tex. He replaces **N. M. Stroup,** who resigned. **R. J. Boren** was advanced from engineer to district petroleum engineer there.

**Volney H. Kyle, Jr.,** has resigned as vice president and operations manager of Michigan-Wisconsin Pipe Line Co. to become a consulting engineer in Grosse Point, Mich.

**Harold G. Mangelsdorf,** a director and executive committeeman of Esso Standard Oil Co., has been named chairman of the Standard Oil Co. (N. J.) advisory committee on human relations. The committee, operative since 1948, has been headed until now by members of the Jersey board. Mangelsdorf will be the first full-time chairman. A veteran in refinery operations, Mangelsdorf joined Esso Standard in 1934 as engineer in Baton Rouge. Later he became assistant general manager there, and in 1950 was named general superintendent at Esso's Bayway refinery in Linden, N. J. He was promoted to manager of the company's East Coast maufacturing in 1952, and became manufacturing manager in 1954.

## Personals

**Jack W. Hudson,** Denver consultant and former general superintendent of Deep Rock Oil Corp., Tulsa (now Crescent Corp), has been named vice president and general manager of Tri-Province Drilling Co., Ltd., Calgary. He replaces **George E. Bentley,** resigned. Before joining Deep Rock, Hudson was general superintendent of Republic Natural Gas Co., Dallas.

**Kenneth A. Spencer,** president of Spencer Chemical Co., has been reelected chairman of the board of trustees of Midwest Research Institute, Kansas City, Mo. **Harry Moreland,** president of Great Lakes Pipe Line Co., was named vice chairman.

**Charles Leslie Rice,** chairman of Oil & Gas Property Management, Inc., and director of Texas Pacific Coal & Oil Co., has been elected a voting trustee of Cuban-Venezuelan Oil Voting Trust. The trust was formed in Havana in 1950 to coordinate management and policy stability of 24 South American oil companies.

**R. B. Claiborne** has been promoted to district drilling superintendent of Warren - Bradshaw Exploration Co.'s northern Oklahoma-Panhandle district, with headquarters in Pampa, Tex. Since 1952, Claiborne has been tool pusher in Pauls Valley, Okla.

## DEATHS

**Dr. Arnold W. Lauer,** 74, who retired in 1934 as division geologist for The Texas Co., died May 15 in Tulsa. Lauer entered the industry in 1914 as a geologist for Shell Oil Co. in Mexico. He had lived in Tulsa since 1919.

**George Brooks Cramer,** 64, retired vice president of the old Powerine Co., Denver, died recently in Covina, Calif. Cramer helped his father, the late Fred C. Cramer, set up Powerine in 1913. He retired in 1945 when the firm was sold to Carter Oil Co.

**S. L. Ensminger,** 32, and **Bennie Lee Aldridge,** 29, Great Bend, Kans., well-service firm executives, were killed May 14 when a plane Ensminger was piloting crashed near Bradley, Okla. Ensminger was president and general manager of Bee Formation Testing Co. of Great Bend. Aldridge was manager there for Welex Jet Service, Inc.

**Harland Hunter Yoakum,** Midland Tex., independent operator, died there May 10.

**William Lawrence Green,** 55, assistant secretary of Standard Oil Co. of California, died May 12 in San Francisco. He had been with the firm since 1919.

**Eugene DeBogory,** 75, president of Empire Oil Co. of New Jersey, Inc., Dallas, died May 13 in Dallas.

**C. L. Huskey,** Oklahoma City well-service firm owner, and his wife drowned May 11 when their boat capsized in Lake Texhoma near Tishomingo, Okla. He owned Huskey Guns, Inc., with offices in Oklahoma City, Pauls Valley, and Stillwater, Okla.

**Levan R. Fleck,** 46, safety manager for Ethyl Corp. in New York, died May 12 in Rutland, Vt., while en route to the American Petroleum Institute's Refining Division meeting in Montreal.

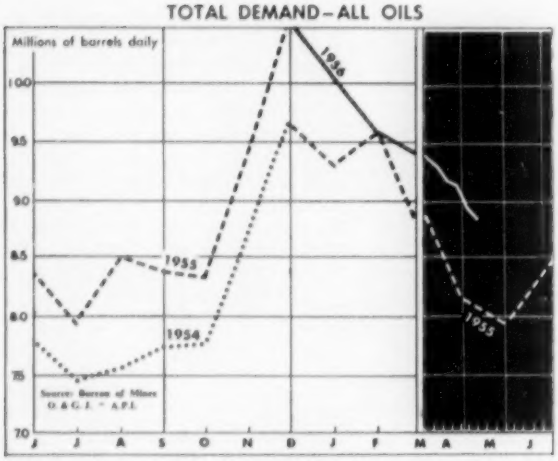
**Harry E. Karnes,** 85, former president of Ada-Belle Oil Co., Beaumont, died there recently.

# Latest Figures . . . Industry Trends

## A QUICK LOOK AT THE HIGHLIGHTS

| | LATEST WEEK | Change from WEEK AGO | | Change from YEAR AGO | |
|---|---|---|---|---|---|
| Production | 7,030,890 | DOWN | 61,355 | UP | 339,160 |
| Crude stocks | 275,420,000 | UP | 1,898,000 | DOWN | 894,000 |
| Completions | 1,122 | UP | 50 | DOWN | 45 |
| Refinery runs | 7,911,000 | UP | 247,000 | UP | 850,000 |
| Gasoline stocks | 187,708,000 | DOWN | 1,512,000 | UP | 16,674,000 |
| Kerosine stocks | 19,332,000 | UP | 983,000 | DOWN | 3,619,000 |
| Distillate stocks | 64,945,000 | UP | 955,000 | DOWN | 7,765,000 |
| Residual stocks | 33,119,000 | DOWN | 97,000 | DOWN | 11,042,000 |
| Four-product stocks | 305,104,000 | UP | 329,000 | DOWN | 5,752,000 |
| Total imports | 1,428,900 | UP | 101,700 | UP | 512,300 |

TOTAL DEMAND—ALL OILS




## Mid-Continent Gasoline Prices Rise; Crude Market Has a Few Soft Spots

INCREASED gasoline prices were firmly established in the Mid-Continent last week. The market took the advance without a quiver.

There were no complaints as refiners fell in line with increases of 0.5 cent on regular and 0.75 on premium, raising the differential 0.25 cent to 1.75. Higher prices began cropping up 2 weeks ago along with a fairly general octane boost of two numbers.

The increases were long expected, of course, as the new 88 and 96-octane motor fuel became available at terminals on the Great Lakes line. Standard Oil Co. (Ind.) extended its 0.5 to 0.8-cent advances in other parts of its marketing area.

Regular was advanced 0.25 cent in California. The increase in tank-wagon prices in the New York-New England area became general.

Firmness characterized the gasoline market generally amid signs that the farm demand had finally started. High-octane fuels were tight on the Gulf Coast. One notable weakness in gasoline was in Philadelphia, where unstable conditions at the retail level depressed tank-wagon prices of major suppliers.

Distillate prices were firm and some inquiries were reported. There was some activity in low-sulfur heavy fuel but none in the high-sulfur product. Other suppliers followed Esso Standard Oil Co. in starting summer price protection for resellers of light heating oils.

Pennsylvania Grade crude rose another 25 cents. Joseph Seep Purchasing Agency for South Penn Oil Co. posted the higher prices effective May 16. The increase was the third of the year and the eighth in the upward trend that started in the fall of 1954. Bradford crude has gone up $1.22 during that period. It resulted from heavy demand by refiners and smaller supply from producers' runs.

**Crude stocks climb . . .** Crude oil inventories have been climbing so rapidly that some producers are having a little trouble moving all the oil permitted under state allowables. The situation has developed into a few soft spots in the crude market.

The trouble can be traced to a single cause, failure to cut crude supply in April. Refinery runs always reach the low point of the year in April if conditions are anywhere near normal. And yet, crude production is never cut enough to prevent an increase in crude stocks. Also, there may be no reduction in crude imports.

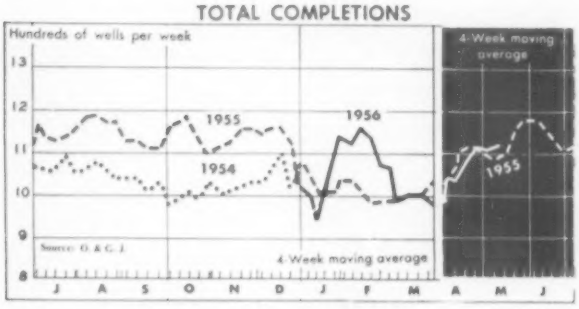
For the past 6 years the average increase in crude stocks during April has been 9,100,000 bbl. In some years the buildup did not cause too much disturbance in the crude market because crude stocks were low at the start of the month.

Crude stocks at the first of April this year amounted to 262,000,000 bbl. or a good working average. Refinery runs dropped to 7,500,000 bbl. daily in April after averaging almost 8,000,000 bbl. daily for the first quarter.

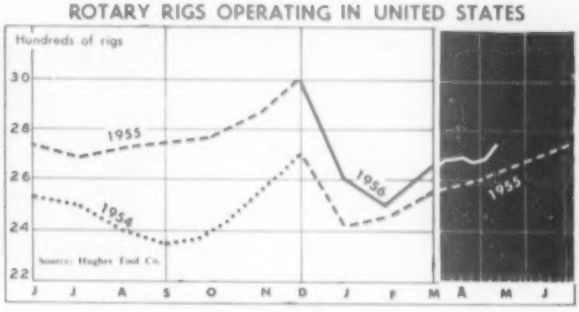
Current figures indicate that total crude production for April topped the records for the first quarter. The net difference between crude supply and demand shows up as an increase in crude inventories amounting to more than 11,500,000 bbl. Weekly reports show a slight reduction in crude imports in April compared with March, but the total for the month was up from January.

If crude stocks are permitted to increase for the balance of May and in June, severe reductions in crude supply will be necessary later this summer.

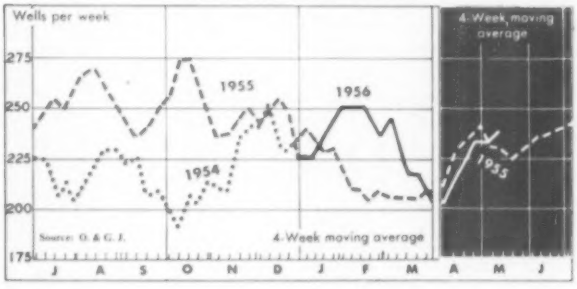
TOTAL COMPLETIONS




ROTARY RIGS OPERATING IN UNITED STATES




WILDCAT COMPLETIONS




ACTIVE ROTARY RIGS*

| Area— | 5-14-56 | 5-7-56 | 5-16-55 |
|---|---|---|---|
| North Central and East | 121 | 121 | 149 |
| Southeast | 34 | 29 | 36 |
| Okla., Kans., Ark., Mo. | 521 | 484 | 524 |
| Louisiana | 435 | 443 | 402 |
| N. and E. Texas-Panhandle | 455 | 440 | 428 |
| Gulf and South Texas | 264 | 255 | 243 |
| West Texas-New Mexico | 565 | 546 | 532 |
| Rocky Mountain | 242 | 241 | 240 |
| Pacific Coast | 127 | 130 | 143 |
| Total United States | 2,764 | 2,689 | 2,697 |
| Western Canada | 176 | 137 | 88 |

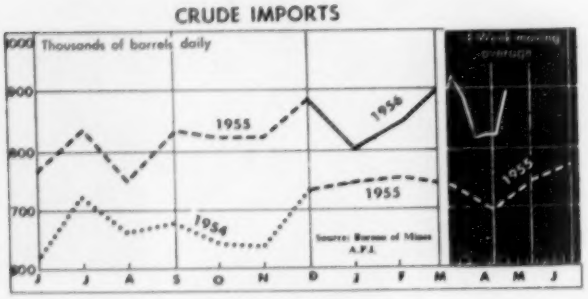
*Hughes Tool Co.

## WEEKLY WELL COMPLETIONS . . . WEEK ENDED MAY 12, 1956

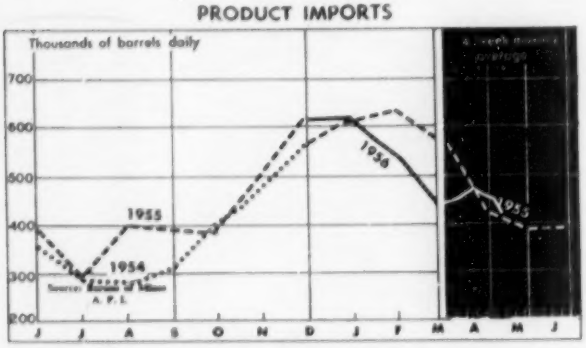
| | Total of all wells | | | | | Cum. | | Wildcat completions and discoveries | | | | | Cumulative total, 1956 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Comp. | Oil | Gas | Dry | Footage | 1956 | 1955 | Oil | Dist. | Gas | Dry | Total | Oil | Dist. | Gas | Dry | Total |
| Ala.-Ga.-Fla. | 4 | 3 | 0 | 1 | 37,510 | 37 | 37 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 18 | 19 |
| Arkansas | 25 | 16 | 0 | 9 | 91,590 | 285 | 241 | 0 | 0 | 0 | 4 | 4 | 13 | 0 | 2 | 44 | 59 |
| California | 33 | 30 | 3 | 0 | 174,708 | 765 | 955 | 1 | 0 | 2 | 0 | 3 | 15 | 0 | 2 | 149 | 166 |
| Colorado | 23 | 5 | 3 | 15 | 120,400 | 415 | 492 | 3 | 0 | 0 | 7 | 10 | 9 | 0 | 6 | 182 | 197 |
| Illinois | 74 | 27 | 1 | 46 | 173,725 | 1,250 | 1,295 | 2 | 0 | 0 | 17 | 19 | 21 | 0 | 0 | 213 | 234 |
| Indiana | 107 | 55 | 8 | †44 | 385,217 | 1,830 | 1,848 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 1 | 40 | 47 |
| Kansas | 12 | 6 | 0 | 6 | 20,273 | 217 | 264 | 2 | 0 | 0 | 14 | 16 | 44 | 1 | 10 | 310 | 365 |
| Kentucky | 37 | 13 | 3 | 21 | 41,612 | 604 | 445 | 2 | 0 | 0 | 13 | 15 | 12 | 0 | 0 | 136 | 148 |
| Louisiana | 84 | 47 | 14 | 23 | 652,343 | 1,370 | 1,361 | 2 | 2 | 6 | 14 | 24 | 39 | 28 | 18 | 170 | 264 |
| North | 28 | 14 | 5 | 9 | 106,751 | 523 | 701 | 0 | 0 | 0 | 6 | 6 | 10 | 1 | 1 | 65 | 77 |
| South | 43 | 23 | 6 | 14 | 415,120 | 675 | 660 | 0 | 1 | 3 | 8 | 12 | 24 | 24 | 8 | 102 | 158 |
| Offshore | 13 | 10 | 3 | 0 | 130,472 | 172 | | 2 | 1 | 3 | 0 | 6 | 5 | 3 | 9 | 12 | 29 |
| Michigan | 9 | 5 | 0 | 4 | 32,010 | 166 | 185 | 0 | 0 | 0 | 3 | 3 | 3 | 0 | 0 | 53 | 56 |
| Mississippi | 14 | 6 | 0 | 8 | 95,917 | 165 | 178 | 2 | 0 | 0 | 3 | 5 | 6 | 0 | 1 | 62 | 69 |
| Montana | 5 | 2 | 0 | 3 | 39,975 | 116 | 116 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 27 | 32 |
| Nebraska | 19 | 6 | 0 | 13 | 109,671 | 341 | 230 | 0 | 0 | 0 | 8 | 8 | 14 | 0 | 0 | 161 | 175 |
| New Mexico | 33 | 22 | 3 | 8 | 119,285 | 647 | 510 | 2 | 0 | 0 | 6 | 8 | 19 | 0 | 5 | 56 | 80 |
| Northwest | 4 | 1 | 3 | 0 | 14,112 | 221 | 138 | 1 | 0 | 0 | 0 | 1 | 2 | 0 | 5 | 14 | 21 |
| Southeast | 29 | 21 | 0 | 8 | 105,173 | 426 | 372 | 1 | 0 | 0 | 6 | 7 | 17 | 0 | 0 | 42 | 59 |
| North Dakota | 5 | 4 | 0 | 1 | 37,150 | 85 | 78 | 0 | 0 | 0 | 1 | 1 | 5 | 0 | 0 | 16 | 21 |
| Ohio | 21 | 14 | 1 | †6 | 52,013 | 384 | 389 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 4 |
| Oklahoma | 154 | 94 | 7 | †53 | 555,334 | 3,181 | 3,129 | 3 | 0 | 3 | 13 | 19 | 48 | 12 | 13 | 262 | 335 |
| Pennsylvania-New York | 2 | 0 | 2 | 0 | 6,494 | *401 | 624 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 5 |
| Texas | 433 | 247 | 16 | 170 | 1,775,676 | 7,824 | 7,092 | 6 | 0 | 4 | 101 | 111 | 286 | 20 | 66 | 1,694 | 2,066 |
| Southwest (1 & 4) | 60 | 26 | 8 | 26 | 270,180 | 1,149 | 1,125 | 2 | 0 | 2 | 18 | 22 | 56 | 5 | 23 | 326 | 410 |
| Gulf Coast (2 & 3) | 45 | 19 | 4 | 22 | 288,722 | 990 | 936 | 0 | 0 | 1 | 12 | 13 | 26 | 8 | 26 | 256 | 316 |
| East (5 & 6) | 37 | 17 | 1 | 19 | 143,792 | 416 | 354 | 0 | 0 | 0 | 11 | 11 | 4 | 1 | 4 | 154 | 163 |
| North Central (7-B & 9) | 161 | 73 | 0 | 88 | 484,036 | 2,763 | 2,511 | 4 | 0 | 0 | 46 | 50 | 126 | 0 | 2 | 655 | 783 |
| West (7-C & 8) | 100 | 89 | 0 | 11 | 462,276 | 2,084 | 1,803 | 0 | 0 | 0 | 11 | 11 | 73 | 0 | 6 | 278 | 357 |
| Panhandle (10) | 30 | 23 | 3 | 4 | 126,670 | 422 | 363 | 0 | 0 | 1 | 3 | 4 | 1 | 6 | 5 | 25 | 37 |
| Utah | 2 | 1 | 0 | 1 | 11,886 | 32 | 26 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 19 | 21 |
| West Virginia | 4 | 0 | 2 | 2 | 5,931 | 236 | 215 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 6 |
| Wyoming | 20 | 7 | 1 | 12 | 87,270 | 267 | 286 | 1 | 0 | 0 | 7 | 8 | 6 | 0 | 4 | 72 | 82 |
| Miscellaneous (Oregon) | 2 | 0 | 0 | 2 | 9,470 | 54 | 15 | 0 | 0 | 0 | 2 | 2 | 4 | 0 | 0 | 41 | 45 |
| Total United States | **1,122** | 610 | 64 | 448 | 4,635,460 | *20,672 | 20,011 | 26 | 2 | 15 | 215 | **258** | 556 | 61 | 136 | 3,743 | 4,496 |
| Total previous week | 1,072 | 615 | 59 | 398 | 4,302,863 | | | 24 | 1 | 6 | 179 | 210 | 530 | 59 | 121 | 3,528 | 4,238 |
| Total May 14, 1955 | 1,167 | 639 | 79 | 449 | 4,529,014 | | | 23 | 2 | 6 | 189 | 220 | 551 | 82 | 126 | 3,412 | 4,171 |
| Cumulative 1956 | *20,672 | 11,434 | 1,322 | 7,916 | 84,695,092 | | | | | | | | | | | | |
| Western Canada | 20 | 11 | 0 | 9 | 115,564 | 823 | | | | | | | | | | | |

Service wells included: *Revised, 11, 18.

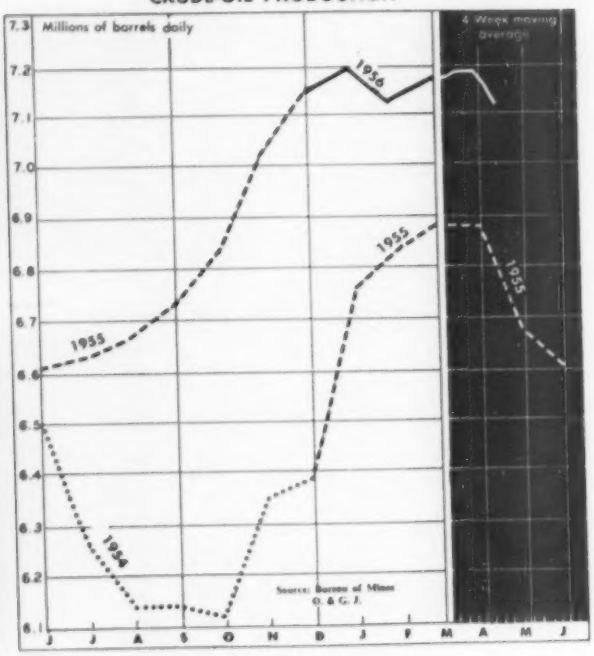
## CRUDE IMPORTS




## PRODUCT IMPORTS




## CRUDE-OIL PRODUCTION

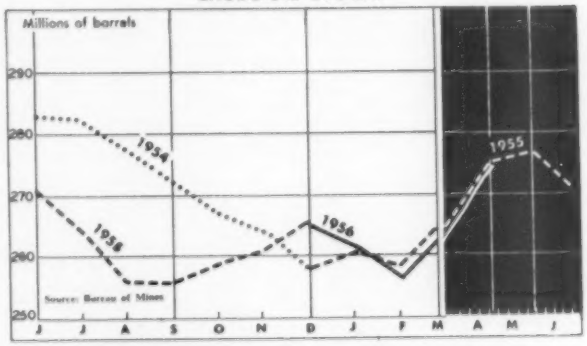



## DAILY AVERAGE PRODUCTION FOR WEEK

| | May 12 Crude oil | May 12 Lease condensate | May 12 Total | May 5 total |
|---|---|---|---|---|
| Alabama | 4,900 | | 4,900 | 4,600 |
| Arkansas | 72,300 | 500 | 72,800 | 73,150 |
| California | 964,800 | | 964,800 | 966,400 |
| Colorado | 162,300 | | 162,300 | 168,400 |
| Eastern | 49,200 | | 49,200 | 48,800 |
| Florida | 1,375 | | 1,375 | 1,375 |
| Illinois | 227,600 | | 227,600 | 231,100 |
| Indiana | 32,000 | | 32,000 | 31,800 |
| Kansas | 335,400 | | 335,400 | 328,400 |
| Kentucky | 48,600 | | 48,600 | 48,800 |
| Louisiana | 730,200 | 60,500 | 790,700 | 803,925 |
| North | 122,200 | 2,500 | 124,700 | 124,200 |
| South | 608,000 | 58,000 | 666,000 | 679,725 |
| Michigan | 28,800 | | 28,800 | 28,400 |
| Mississippi | 107,000 | 3,700 | 110,700 | 110,875 |
| Montana | 51,900 | | 51,900 | 51,300 |
| Nebraska | 40,800 | | 40,800 | 35,800 |
| New Mexico | 241,300 | 3,200 | 244,500 | 247,955 |
| North Dakota | 27,300 | | 27,300 | 29,700 |
| Oklahoma | 576,500 | | 576,500 | 596,200 |
| Texas | 2,924,000 | 51,215 | 2,975,215 | 3,000,165 |
| Dist. 1 | 54,800 | 425 | 55,225 | 55,100 |
| Dist. 2 | 150,000 | 8,175 | 158,175 | 158,600 |
| Dist. 3 | 425,700 | 25,000 | 450,700 | 452,125 |
| Dist. 4 | 235,000 | 4,900 | 239,900 | 243,750 |
| Dist. 5 | 45,000 | 450 | 45,450 | 45,450 |
| Dist. 6 | 122,000 | 5,850 | 127,850 | 129,425 |
| East Texas Field | 209,500 | | 209,500 | 211,850 |
| Dist. 7-B | 152,000 | 50 | 152,050 | 155,900 |
| Dist. 7-C | 185,000 | 4,005 | 189,005 | 190,730 |
| Dist. 8 | 1,042,000 | 1,800 | 1,043,800 | 1,051,525 |
| Dist. 9 | 209,000 | 400 | 209,400 | 211,125 |
| Dist. 10 | 94,000 | 160 | 94,160 | 94,585 |
| Utah | 5,200 | | 5,200 | 5,200 |
| Wyoming | 280,100 | | 280,100 | 279,600 |
| Others | ‡200 | | ‡200 | 300 |
| Total U. S. | 6,911,775 | 119,115 | 7,030,890 | 7,092,245 |
| Change from previous week, down | | | 61,355 | |
| Canada | †380,264 | | †380,264 | 360,100 |
| Total U. S. production January 1-May 12 | | | | 946,327,375 bbl. |
| Same period last year (crude plus cond.) | | | | *901,265,650 bbl. |

*Includes 15,189,500 bbl. condensate. ‡Week ended previous Monday. ‡Nevada.

## CRUDE-OIL STOCKS



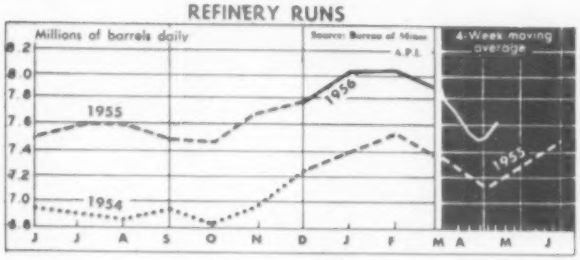

## CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

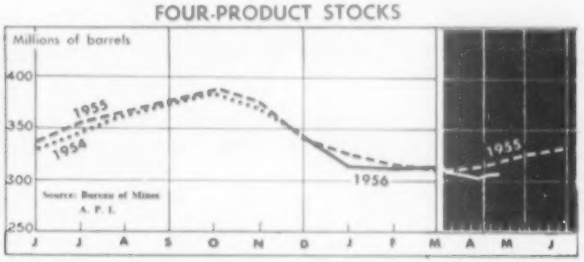
| | 5-5-56 | 4-28-56 | 5-7-55 |
|---|---|---|---|
| Pennsylvania Grade | 2,737 | 2,664 | 2,876 |
| Other Appalachian | 2,230 | 2,293 | 1,945 |
| Illinois, Indiana, Michigan | 9,637 | 9,790 | 11,827 |
| Nebraska, North Dakota | 2,313 | 2,214 | 2,170 |
| Kansas | 9,024 | 8,808 | 8,849 |
| Oklahoma | 25,349 | 25,614 | 24,907 |
| Arkansas | 3,181 | 3,033 | 2,841 |
| Louisiana | 17,457 | 16,488 | 15,740 |
| North | 2,627 | 2,584 | 2,693 |
| South | 14,830 | 13,904 | 13,047 |
| Mississippi | 3,124 | 3,029 | 2,760 |
| New Mexico | 7,828 | 8,120 | 8,743 |
| Texas | 127,269 | 127,751 | 128,823 |
| East Texas proper | 9,425 | 9,608 | 10,569 |
| West Texas | 62,809 | 63,243 | 54,974 |
| Texas Gulf | 22,630 | 22,403 | 26,115 |
| Other Texas | 32,405 | 32,497 | 37,165 |
| Wyoming | 17,587 | 16,874 | 15,479 |
| Other Rocky Mountain | 5,988 | 5,856 | 5,261 |
| California | 28,542 | 28,331 | 32,035 |
| Foreign | †13,154 | 12,657 | 12,058 |
| Total | 275,420 | 273,522 | 276,314 |

*Bureau of Mines. †Includes 2,315,000 bbl. in California.

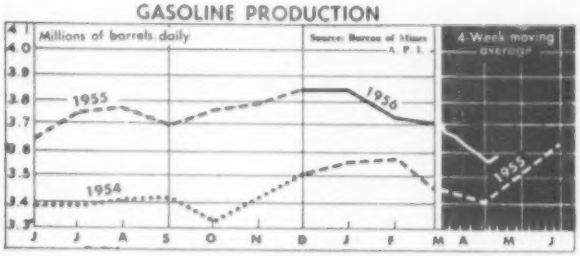
REFINERY RUNS



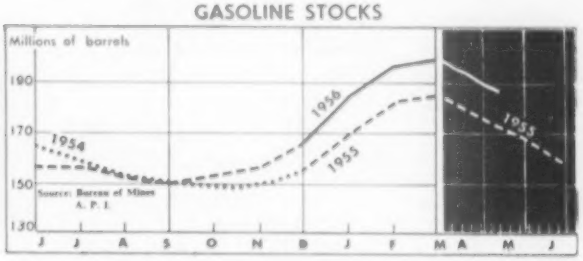

FOUR-PRODUCT STOCKS



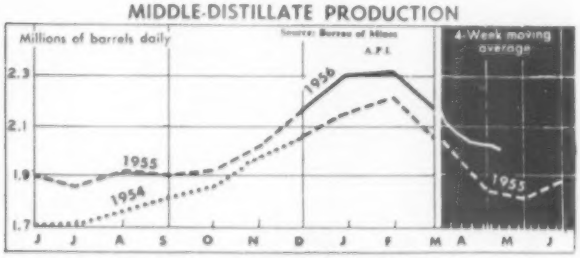

GASOLINE PRODUCTION



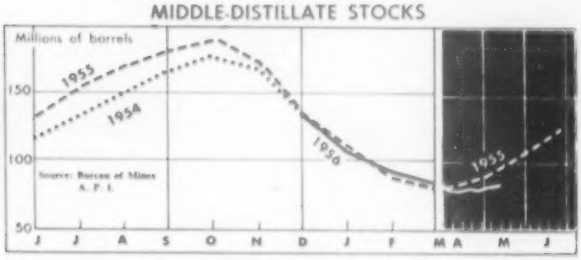

GASOLINE STOCKS



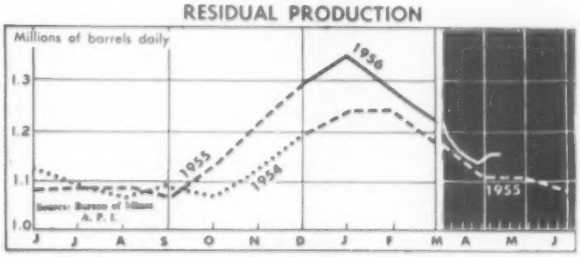

MIDDLE-DISTILLATE PRODUCTION



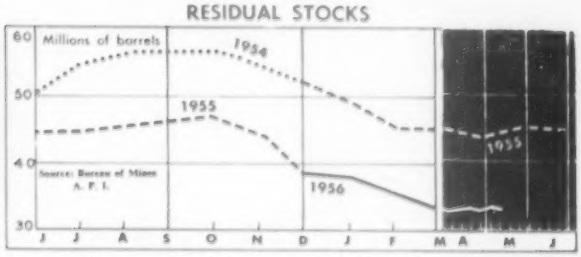

MIDDLE-DISTILLATE STOCKS




RESIDUAL PRODUCTION




RESIDUAL STOCKS




## A.P.I. REFINERY REPORT, MAY 11

(Thousands of barrels)

| District— | Daily avg. runs | Daily average production—Gaso.* | Kero. | Dist. | Resid. | Stocks‡—Gaso.† | Kero. | Dist. | Resid. | Bureau of Mines, May 1955—Daily avg. runs | Daily average production—Gaso.* | Kero. | Dist. | Resid. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| East Coast | 1,109 | 441.0 | 27.4 | 234.7 | 210.7 | 39,579 | 7,298 | 17,739 | 7,591 | 1,003 | 390.2 | 31.0 | 233.2 | 179.5 |
| Appalachian: | | | | | | | | | | | | | | |
| District 1 | 100 | 36.3 | 4.3 | 25.1 | 5.1 | 4,601 | 380 | 1,241 | 306 | 82 | 34.3 | 2.1 | 18.0 | 3.5 |
| District 2 | 108 | 52.0 | 6.3 | 13.7 | 14.9 | 2,965 | 525 | 628 | 207 | 98 | 52.6 | 3.0 | 13.7 | 11.2 |
| Ind., Ill., Ky. | 1,368 | 703.2 | 70.0 | 256.1 | 170.2 | 39,539 | 3,430 | 10,391 | 3,840 | 1,345 | 678.0 | 66.7 | 243.1 | 158.7 |
| Okla., Kans., Mo. | 720 | 396.1 | 26.6 | 152.3 | 25.4 | 19,922 | 904 | 7,080 | 1,061 | 642 | 352.0 | 16.1 | 150.8 | 33.5 |
| Inland Texas | 269 | 185.7 | 12.1 | 47.1 | 24.9 | 6,797 | 411 | 1,466 | 1,406 | 251 | 190.0 | 8.4 | 47.8 | 22.9 |
| Texas Gulf Coast | 2,002 | 938.2 | 112.7 | 497.2 | 244.4 | 26,681 | 3,036 | 9,595 | 5,115 | 1,804 | 851.9 | 104.1 | 405.0 | 254.4 |
| La. Gulf Coast | 689 | 358.0 | 45.3 | 178.0 | 56.1 | 10,232 | 2,452 | 4,916 | 1,690 | 626 | 328.0 | 49.1 | 171.5 | 49.5 |
| N. La. and Ark. | 79 | 26.9 | 4.9 | 18.6 | 6.1 | 4,374 | 243 | 1,245 | 52 | 95 | 33.5 | 7.1 | 23.7 | 5.1 |
| Rocky Mountain: | | | | | | | | | | | | | | |
| New Mexico | 20 | 10.1 | | 3.4 | 2.4 | 363 | 1 | 81 | 24 | 21 | 10.0 | 0.3 | 3.6 | 2.8 |
| Other Rocky Mtn. | 265 | 116.0 | 3.4 | 60.3 | 30.9 | 7,596 | 262 | 2,135 | 754 | 235 | 106.5 | 2.0 | 57.8 | 35.1 |
| California | 1,182 | 508.4 | 10.3 | 150.9 | 386.6 | 25,059 | 390 | 8,428 | 11,073 | 1,066 | 480.9 | 5.7 | 151.0 | 354.3 |
| May 11, 1956 | 7,911 | 3,771.9 | 323.3 | 1,637.4 | 1,177.7 | 187,708 | 19,332 | 64,945 | 33,119 | 7,268 | 3,507.9 | 295.6 | 1,519.2 | 1,110.5 |
| May 4, 1956 | 7,664 | 3,532.1 | 325.1 | 1,711.3 | 1,162.1 | 189,220 | 18,349 | 63,990 | 33,216 | | | | | |
| May 13, 1955 | 7,061 | 3,488.0 | 295.7 | 1,434.3 | 1,067.1 | 171,034 | 22,951 | 72,710 | 44,161 | | | | | |

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

# Crude-oil and refinery prices at representative U. S. and foreign points

## REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

### GASOLINE*

**Mid-Continent (Group 3):**

| | |
|---|---|
| ★ Regular (88 octane) | 11.75-12.00 |
| ★ Premium (96 octane) | 13.50-13.75 |

**Gulf Coast (cargoes for coastwise or export movement):**

| | |
|---|---|
| Regular (90 octane) | 11.25-11.50 |
| Regular (92 octane) | 11.50-12.00 |
| Premium (97 octane) | 13.00-13.25 |
| Premium (98 octane) | 13.25-13.75 |

**California—Los Angeles (rack):**

| | |
|---|---|
| ★ Regular (84 octane) | 12.9-13.40 |
| Premium (93 octane) | 14.0-14.25 |

**Caribbean area (cargoes):**

| | |
|---|---|
| Regular (87 octane) | 10.50 |
| Premium (93 octane) | 11.75 |

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

### NATURAL GASOLINE*

| | |
|---|---|
| **Group 3:** | |
| Grade 26-70 | 4.5 |
| **Breckenridge:** | |
| Grade 26-70 | 4.0 |

*If 26-70 natural is considered as 100 per cent, prices for lower-vapor-pressure grades increase 2.5 per cent for each unit drop in Reid vapor pressure down to and including 16-lb. Prices for grades below 16-lb. may vary slightly by areas or plants.

### KEROSINE AND DISTILLATE

**Mid-Continent (Group 3):**

| | |
|---|---|
| Kerosine 42-44 | 10.00-10.25 |
| Diesel oil (58 d.i. and above) | 9.625-9.875 |
| Distillate No. 1 | 9.625-9.875 |
| Distillate No. 2 | 9.00-9.25 |

**Gulf Coast (cargoes):**

| | |
|---|---|
| Kerosine 41-43 | 9.5 |
| Distillate No. 2 | 8.75-9.25 |

**New York Harbor (barges):**

| | |
|---|---|
| Kerosine 41-43 | 10.85 |
| Distillate No. 2 | 10.35 |
| Diesel fuel, 48-52 d.i. | 10.65 |

**Caribbean area (cargoes):**

| | |
|---|---|
| Distillate No. 2 | 8.75 |

### WAX (LB.)

**Oklahoma (Group 3):**

| | |
|---|---|
| 132-135 A.m.p. (semi-refined) in tank cars | 6.50 |

**New York (export):**

| | |
|---|---|
| 126-130 A.m.p. crude scale (solid in bags or barrels) | 7.35 |

★ Denotes change from previous week.

### RESIDUAL FUEL (BBL.)

| | |
|---|---|
| **Mid-Continent (Group 3):** | |
| Residual fuel (max. 1% S) | $2.00-2.10 |
| **Gulf Coast (cargoes):** | |
| Bunker C fuel | $2.10 |
| **New York Harbor (barges):** | |
| Bunker C fuel | $2.65 |
| **Caribbean (cargoes):** | |
| Bunker C at Aruba, N.W.I. | $2.10 |
| **California (rack):** | |
| Bunker C fuel, Los Angeles | $2.10-2.20 |

### LUBRICATING OILS

| | |
|---|---|
| **Mid-Continent (Group 3):** | |
| 150-160 bright stock, solvent refined, 0-10 p.p., 95 v.i. | 24 |
| 200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i. | 20.75 |
| **Pennsylvania Grade:** | |
| 145-155 vis. at 210, bright stock, 8 color, 25 p.t. | 24 |
| 200 vis. neutral (180 at 100°), 25 p.t. | 21 |

## CRUDE-OIL PRICES

### GRAVITY SCHEDULE

| | Signal Hill, Calif. | Mid-Cont.* | Gulf Coast Tex.† | West Tex.‡ N.M. | Wyo. (sour) |
|---|---|---|---|---|---|
| 14-14.9 | $2.02 | .... | .... | .... | .... |
| 15-15.9 | 2.08 | .... | .... | .... | .... |
| 16.16.9 | 2.13 | .... | .... | .... | .... |
| 17-17.9 | 2.19 | .... | .... | .... | .... |
| 18-18.9 | 2.24 | .... | .... | .... | .... |
| 19-19.9 | 2.30 | .... | .... | .... | .... |
| 20-20.9 | 2.35 | $2.50 | .... | $2.37 | .... |
| 21-21.9 | 2.41 | 2.52 | .... | 2.39 | .... |
| 22-22.9 | 2.47 | 2.54 | .... | 2.41 | .... |
| 23-23.9 | 2.52 | 2.56 | .... | 2.43 | .... |
| 24-24.9 | 2.58 | 2.58 | $2.91 | 2.45 | .... |
| 25-25.9 | 2.64 | 2.60 | 2.93 | 2.47 | .... |
| 26-26.9 | 2.69 | 2.62 | 2.95 | 2.49 | .... |
| 27-27.9 | 2.76 | 2.64 | 2.97 | 2.51 | .... |
| 28-28.9 | 2.83 | 2.66 | 2.99 | 2.53 | .... |
| 29-29.9 | 2.91 | 2.68 | 3.01 | 2.55 | .... |
| 30-30.9 | 2.97 | 2.70 | 3.03 | 2.57 | .... |
| 31-31.9 | 3.04 | 2.72 | 3.05 | 2.59 | $2.46 |
| 32-32.9 | 3.12 | 2.74 | 3.07 | 2.61 | 2.48 |
| 33-33.9 | 3.20 | 2.76 | 3.09 | 2.63 | 2.50 |
| 34-34.9 | 3.27 | 2.78 | 3.11 | 2.65 | 2.52 |
| 35-35.9 | 3.34 | 2.80 | 3.13 | 2.67 | 2.54 |
| 36-36.9 | 3.39 | 2.82 | 3.15 | 2.69 | 2.56 |
| 37-37.9 | .... | 2.84 | 3.17 | 2.71 | 2.58 |
| 38-38.9 | .... | 2.86 | 3.19 | 2.73 | 2.60 |
| 39-39.9 | .... | 2.88 | 3.21 | 2.75 | 2.62 |
| 40 and up | .... | 2.90 | 3.23 | 2.77 | 2.64 |

*Includes Oklahoma, Kansas, North Dakota, West Texas (sweet), North Central Texas, North Louisiana, Arkansas, and Wyoming (sweet). †Low-cold-test Gulf Coast. ‡Sour.

Effective dates: California, February 7, 1956; east of California, June 15, 1953; Pennsylvania Grade, March 16, 1956.

### FLAT PRICES

| | |
|---|---|
| **Louisiana:** | |
| Cotton Valley (distillate) | $3.00 |
| Cotton Valley (Holloway crude) | 2.95 |
| **Texas:** | |
| East Texas | 2.90 |
| Chapel Hill | 2.83 |
| Conroe | 3.13 |
| Van | 2.73 |
| **Pennsylvania Grade:** | |
| ★ Bradford | 4.45 |
| ★ Middle District | 4.32 |
| ★ Southwest Pennsylvania | 4.03 |
| ★ West Virginia | 3.91 |
| Buckeye Grade | 3.60 |
| Zanesville Grade | 3.02 |
| **Illinois Basin** | 3.00 |
| **Canada:** | |
| Leduc-Woodbend (flat prices D-2, D-3) | 2.60 |
| Redwater (Alta.) D-3 | 2.49 |
| Smiley-Viking (Sask.) | 2.26 |
| Fosterton (Sask.) | 1.29 |
| Pembina | 2.52 |

### FOREIGN

| | |
|---|---|
| **Venezuela:** | |
| Cumarebo, 48°-48.9°, Tucupido | *3.40 |
| San Joaquin, 41°-41.9°, Puerto La Cruz | *3.04 |
| Oficina, 35°-35.9°, Puerto La Cruz | *2.80 |
| Tia Juana medium, 26.5°-26.9°, Amuay | †2.30 |
| Quiriquire, 16.5°-16.9°, Caripito | ‡2.21 |
| Lagunillas heavy, flat, Amuay or Las Piedras§ | 2.05 |
| Bachaquero, 16.5°-16.9°, Amuay or Las Piedras§ | ‡1.90 |

*Plus or minus 2 cents per barrel for each degree gravity change. †Plus or minus 2.5 cents per barrel for each half-degree gravity change. ‡Plus or minus 3.5 cents per barrel for each half-degree gravity change. §Also available at La Salina at 3.0 cents per barrel less.

| | |
|---|---|
| **Middle East, Persian Gulf (cargoes, f.o.b. lifting port):** | |
| Arabian, 36.0°-36.9°, Ras Tanura | $1.97 |
| Iranian, 34.0°-34.9°, Bandar Mashur | 1.91 |
| Iranian, 34.0-34.9°, Abadan | 1.86 |
| Iraq, 36.0-36.9°, Fao | 1.87 |
| Kuwait, 31.0°-31.9°, Mina-al-Ahmadi | 1.72 |
| Qatar, 39.0°-39.9°, Umm Said | 2.06 |
| **Middle East, E. Mediterranean:** | |
| Arabian, 36.0°-36.9°, Sidon | 2.46 |
| Iraq, 36.0°-36.9°, Tripoli, Banias | 2.46 |
| **Far East (cargoes, f.o.b. Lutong, Sarawak):** | |
| Seria Light, 37°-38° | 2.60 |

### TANKER RATES (PER LONG TON)

(Latest reported spot fixtures)

| | |
|---|---|
| ★Gulf-U.S.N.H., clean (USMC+75%) | $4.99 |
| ★NWI-U.S.N.H., dirty (USMC+67.5%) | 4.52 |
| ★Gulf-U.K., clean (MOT+125%) (85s. 6d.) | 11.63 |
| ★NWI-U.K., clean (MOT+125%) (73s. 2d.) | 9.95 |
| ★NWI-U.K., dirty (Scale+92.5%) (62s. 7d.) | 8.51 |
| ★Sidon-U.S.N.H., dirty (USMC+27.5%) | 9.94 |
| ★P.G.-France, dirty (USMC+32.5%) | 14.44 |
| ★P.G.-U.K., dirty (Scale+115%) (116s. 3d.) | 15.81 |
| ★P.G.-U.K., dirty (MOT+130%) (124s. 2d.) | 16.89 |

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U-15 DRILLING RIG located in Beaver County, 3 NKU Waukesha Motors. Hydraulic Floor Operated Blowout Preventor, 131' Lee C. Moore Mast, steel mud pits, 7¾ x 16 Gardner-Denver pump, 8000' 4½" Drill Pipe recomplete. Call CEntral 2-6318, Oklahoma City, Oklahoma.

RECORDING INSTRUMENTS, fair condition, mounted on good truck. Dual power reels and cables. Bargain. Box J-460. The Oil and Gas Journal, Tulsa, Oklahoma.

LINE PIPE: 2500' 7" OD 17 lb. Good body. 40' random lengths. Clean, straight, beveled, ready to lay. $1.00. M. J. Regan Pipe Co., Coffeyville, Kans.

4150 ft. 3½" OD. 9.3 lbs. 8 rt. thread upset Tubing. 85c per ft. Approx 25,000 ft. ⅞ J. 7. Sucker Rods. A1 condition. 20c per ft. Box 4671 or MElrose 7-4444, Oklahoma City.

**BROWN-STRAUSS CORPORATION**

**LIQUIDATING**

**PURE OIL REF., CHARLESTON, W. VA. AND BAY REF., McPHERSON, KANSAS**

HOT OIL PUMPS—Simplex, Duplex, Centrifugal, 100 to 400 GPM, 100 to 1500 PSI-Steam, Electric Motor, Gas & Diesel Drives.
STEAM PUMPS, Simplex & Duplex, 72 to 500 GPM, 100 to 1500 PSI.
FRACTIONATOR, 6'-6" x 98'-0", Shell ¾", Heads ⅝", 40 trays.
GYRO FRACTIONATOR, 6'-6" x 72'-0", Shell & Heads ¾", 16 Trays.
CLAY TOWERS, 12'-0" x 30'-6", Shell & Heads ¾", No Trays.
STABILIZER, 3'-0" x 55'-0", Shell & Heads ¾" Top Hd. Flgd.
NAPHTHA FLASH TOWER, 3'-0" x 37'-6", Shell & Heads ⅜", 7 Trays.
STABILIZER, 3'-0" x 49'-0", Shell & Heads, 11/16", 30 Trays.
STABILIZER, 4'-0" x 48'-0", Shell & Heads ⅝", 39 Trays.
FRACTIONATOR, 3'-6" x 86', Shell & Heads ⅜", 22 Trays.
FLASH TOWER, 7'-6" x 32'-6", Shell & Heads ⅞", No Trays.
Other Towers & Pressure Vessels, various sizes & Pressures.
Over 100 Heat Exchangers, Condensers, Reboilers, & Coolers from 80 to 1500 sq. ft. capacity, Admiralty & Steel Tubes.
Updraft Heaters, Cracking & Reformer Heaters.
Ethyl Lead Blending Unit, 8500 gal. cap. tank, complete.
Compressors, Gas & Steam Driven.
Sharpless Centrifuges, Oil Filter Presses, Chillers, etc.
Tank Plate ¼"-¼" and ⅜"—large size sheets.
Valves—Fittings—Used Structural Steel.

**MANY OTHER ITEMS—**

**WRITE FOR CATALOGUE**

**BROWN-STRAUSS CORPORATION**

**1548 Guinotte Ave., Kansas City Mo., Phone HA 1-1000**
**Field Office: Cabin Creek (suburb of Charleston, W. Va.)**
**Phone East Bank 5611. Roy Crisp, Mgr. P. O. Box 2921, Charleston, W. Va.**

## FOR SALE EQUIPMENT

CLARK MA-4 Compressor Cylinders, complete. 7 new 13" x 8", 7 used 7¾" x 8", excellent condition. Priced to sell. Write Consolidated Gas Utilities Corporation, Box 1439, Oklahoma City, Oklahoma.

**NEW STEEL PIPE**

20,000 feet 4" standard buttweld 10.8 pound x 20' R.L.
10,000 feet 4" standard electric weld 7.25 pound x 40' R.L.

**IMMEDIATE SHIPMENT**
**SUBJECT TO PRIOR SALE**

Phone Write Wire

**BROWN-STRAUSS CORPORATION**

**1548 Guinotte Kansas City, Mo.**
**Phone HA 1-1000**

## EQUIPMENT WANTED

WANTED: Joy or Fuller Compressors. Give description and price. P. O. Box 1732, Tulsa, Okla.

USED 315 cubic foot portable air compressor with or without engine. Green Machinery Co., Inc., 1201 East 5th St., Plainview, Texas.

PIPE WANTED. We are constantly in the market for carloads of used or substandard pipe 8⅝ and upwards. Box J-534, The Oil and Gas Journal, Tulsa, Oklahoma.

2 MAYHEW SEISMOGRAPH RIGS—1 Model 600 mounted on 1954 F6 Ford with desired amount drill stem—4½ x 5 Gardner-Denver Pump. 1 Model 1000 mounted on 1952 F6 Ford with 300' drill stem—5 x 6 Gardner-Denver Pump. This equipment is in excellent condition. International Drilling Corporation, 314 Enterprise Building, Tulsa, Oklahoma.

## HELP WANTED

FOREIGN EMPLOYMENT. List of oil companies and drilling contractors showing where to apply for foreign jobs. OIML Co., Box 2803, Tulsa, Okla. $5.00 cash.

WANT REPRESENTATIVE in South America for specialized line of oilfield production equipment. Commissions are far above average. Send resume giving sales outlets and sales force. Box J-491, The Oil and Gas Journal, Tulsa, Oklahoma.

**PETROLEUM ENGINEERS**

Experienced graduate engineers for immediate openings in Saudi Arabia and New York City. For engineering work in development, production, drilling, process, and oil and gas engineering on primary and secondary recovery problems.

**RESERVOIR FLUID ANALYST**

With degree in Physical Chemistry or Chemical Engineering plus 5 years' petroleum production engineering experience which should include 2 years' study of reservoir fluid behavior.

*Salaries commensurate with training and experience. Write outlining personal history and work experience. Please include telephone number.*

***Recruiting Supervisor, Box 116***

**ARABIAN-AMERICAN OIL COMPANY**

**505 PARK AVENUE**

## HELP WANTED

**OVERSEAS EMPLOYMENT OPPORTUNITIES**

Major oil company operating in the Middle East has attractive positions open for qualified experienced supervisory personnel:

PETROLEUM ENGINEERS—Several vacancies for Petroleum Engineers experienced in drilling, production, reservoir, or equipment engineering.

DRILLING SUPERINTENDENTS—Fully qualified area drilling superintendents required. Must be capable of planning, organizing and supervising major drilling programs involving deep tests in high pressure areas. Will be required to administer and supervise work performed by drilling contractors.

FIRE PROTECTION SUPERVISORS—Must be fully qualified to train personnel and maintain efficiency of fire protection services in large oil refinery or in producing field installations.

ELECTRICAL SUPERVISORS—Previous supervisory experience in oil or other heavy industry required. Will be responsible for maintenance and repairs for oil fields electrical installations; including generating plants, sub-stations, distribution networks, shop areas, etc.

MECHANICAL SUPERVISORS—Must be fully qualified to supervise maintenance and repairs of mechanical equipment required for oil fields operations including drilling and production equipment, pumps, heavy construction equipment, etc.

Write, giving age, marital status, education and details of previous experience.

**Box 308-O**
**Radio City Station**
**New York 19, N. Y.**

HELP WANTED

WANTED: Man for teaching staff and part-time research in Petroleum Engineering at Rocky Mountain School. Should have M.S. or better and some oil industry experience. State general qualifications in letter. Salary open. Jox J-517, The Oil and Gas Journal, Tulsa, Oklahoma.

## REFINERY OPERATORS

**With minimum 7 years' oil refining experience. Must have experience on process units, such as crude distillation, thermal reforming, fluid catalytic cracking and reforming and thermal cracking. For refinery operation in Saudi Arabia.**

**Write outlining personal history and work experience.**

*Recruiting Supervisor, Box 136*

**ARABIAN AMERICAN OIL COMPANY**

505 PARK AVENUE

NEW YORK 22, N. Y.

HELP WANTED

GEOPHYSICIST WANTED; Position open for experienced seismologist, supervisory work—West Texas-Southeast New Mexico area. Headquarters Midland, Texas. Requirements eight years minimum experience; one to two years West Texas-Southeast New Mexico. In reply give personal data, educational qualifications, and details of professional experience. Box J-535, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER. Active independent Oil Company has vacancy for graduate petroleum engineer for work in the Gulf Coast area. Experience in drilling and production desirable but not mandatory. In first reply give resume of education and experience and salary desired. All replies will be held in strict confidence. Box J-505, The Oil and Gas Journal, Tulsa, Oklahoma.

## Drilling Production Engineer

Independent drilling and production company operating in Mid-Continent area has opening for young graduate petroleum engineer specializing in drilling techniques and machinery. Must have field experience. Will work closely to manager of operations. Good personality essential. Age limit under 35. Give past employment record and educational background in reply. Reply

**Box J-515,**
**The Oil and Gas Journal,**
**Tulsa, Oklahoma.**

HELP WANTED

EXPLORATION EXECUTIVE—Independent oil producing corporation operating in Mid-Continent field desires experienced man presently employed in middle or top-management exploratory capacity. Please furnish age, education, experience, references and salary required. All replies will be kept confidential. Box J-503, The Oil and Gas Journal, Tulsa, Oklahoma.

## Petroleum Geologists

Established Oil Company desires geologists for employment in West Texas area. Must know area and have four to six years of active experience in subsurface mapping and interpretation. Excellent opportunity for advancement. Salary will be commensurate with ability and experience. Reply should state age, education, experience, and salary desired.

BOX J-485,
THE OIL AND GAS JOURNAL,
TULSA, OKLAHOMA.

## PETROLEUM ENGINEERS

*For drilling production and equipment on varied types active fields.*

EXCELLENT SALARY, ALLOWANCES, OPPORTUNITY OBTAIN ADDITIONAL EXPERIENCE & ADVANCEMENT.

*Positions Available Venezuela & Colombia. Graduate Engineers—minimum 2 years exp.*

Forward Personal data, college transcript, to:

C. L. LAUE

**SOCONY MOBIL**
OIL CO., INC.

26 Broadway, New York 4, New York

## OVERSEAS OPPORTUNITIES

**Affiliates of**

## STANDARD OIL COMPANY (New Jersey)

**Located in**

## SOUTH AMERICA

*. . . Have staff positions now open for:*

**MAINTENANCE ENGINEERS:**
Will plan, schedule and coordinate oil refinery maintenance and construction projects and/or provide technical assistance to refinery crafts.

**PROJECT ENGINEERS:**
Assignments may include project development, cost estimation, materials specifications, design and drafting, and construction follow-up.

**PROCESS ENGINEERS:**
Work assignments may involve process design and control, economic studies, and/or scheduling of refinery operating programs.

**EQUIPMENT INSPECTION ENGINEERS:**
Will inspect refinery equipment and request equipment renewals when necessary due to corrosion or failure under safty codes.

**PETROLEUM ENGINEERS:**
Assignments will be of general Petroleum Engineering nature. Emphasis will be placed on equipment and production or cost and engineering analysis.

Engineering degree and minimum of two years experience in oil refinery or allied chemical industry required.

Liberal salaries, benefit plans, and vacation policy.

**WRITE**

Giving complete address, age, marital status, education and details of previous experience, Box 308-W, Radio City Station, New York 19, N. Y.

## Petroleum Engineers

**(South America)**

Graduate engineers with experience in drilling, production, reservoir and equipment. Working knowledge of Spanish desirable but not essential.

## Lubrication Engineers

**(West Africa)**

Mechanical Engineer's degree and experience in lubrication and petroleum products. Fluent French not essential but working knowledge desirable.

## Operations Supervisor

**(West Africa)**

Experienced all phases construction engineering concerning marketing petroleum products, i.e., appropriations, terminal layout and maintenance. M.E. or C.E. degree desirable but not essential. Working knowledge French essential.

**LIBERAL EMPLOYE BENEFIT PLANS**
**SALARY COMMENSURATE WITH EXPERIENCE**
**Forward resume of education and experience to**

**THE TEXAS COMPANY**
**Foreign Personnel Office**
135 East 42nd Street
NEW YORK 17, N. Y.

HELP WANTED

RESERVOIR ENGINEERS with minimum of four years experience wanted by expanding medium sized major oil company. Staff positions are in southwest locations. Please furnish information on degree held, detailed experience and state salary expected. All replies held confidential. Box J-536, The Oil and Gas Journal, Tulsa, Oklahoma.

## Construction ENGINEERS

**FOREIGN EMPLOYMENT**

Graduate Electrical, Mechanical, Civil or Chemical Engineers with minimum 10 years' experience supervising construction of industrial buildings, oil processing and oil handling facilities. Engineering degree essential. To assist in constructing expanding company facilities of major foreign operating oil company located in Saudi Arabia. Generous salary plus living allowance; liberal all-inclusive benefit program.

Write giving full particulars regarding personal history and work experience.

**Recruiting Supervisor, Box 152**

**ARABIAN AMERICAN OIL COMPANY**

**505 Park Avenue**
**New York 22, N. Y.**

## DESIGN ENGINEERS

You can fill a desirable **permanent** position in McKee's enlarged Refinery, Metals or Industrial Divisions. Our expansion program gives you excellent opportunity for advancement in one of the world's largest engineering firms.

World-wide McKee operation offers you wide choice in the design of Petroleum Refineries, Chemical Plants, Blast Furnaces, Steel Plants, Sintering Plants and Industrial Plants in the following fields:

**Piping Layout, Structural Steel, Concrete, Process Heaters, Equipment Specifications, Layout and Process Design. Also Piping and Electrical Draftsmen.**

You get top compensation, the security of a life-long pension, paid vacations, benefits of insurance, hospitalization, sick-leave pay and training program.

You'll work with modern equipment in large air-conditioned quarters. Free parking on premises.

Cleveland has attractive residential areas, excellent schools and colleges for you and your family. McKee makes generous transportation and moving allowances.

Write for an interview giving education and experience. No age limitations. All letters kept strictly confidential. Write today to:

EDWARD A. KOLNER

**ARTHUR G. McKEE & COMPANY**

2300 Chester Avenue
Cleveland 1, Ohio

HELP WANTED

## GEOLOGICAL PARTY CHIEFS

Major American oil company has interesting openings for experienced Party Chiefs with assignments in Europe and North Africa.

Attractive salaries, pension plan, home furloughs and expenses provided.

Interviews will be arranged at time and place convenient to candidates.

Write giving age, marital status, education and complete details of experience.

**Box 308-S**
**Radio City Station**
**New York 19, N. Y.**

HELP WANTED

**TOP REPRESENTATIVE WANTED FOR RUBBER GOODS MFGR.**

Expanding operations of Molded and Lathe Cut items to customer requirements. Currently servicing the Oil Field Suppliers with packers, etc. Rubber experience helpful but not necessary. Send confidential details to

**Box J-522,**
**The Oil and Gas Journal,**
**Tulsa, Oklahoma.**

## NATURAL GASOLINE PLANT ENGINEER

To conduct field investigations for possible new plant locations (any size) and to supervise contract negotiations, plant design and operations for substantial independent company. Should have broad knowledge of the oil and gas producing areas and successful background of plant operations. Replies should state age, outline personal history and work experience. Replies kept strictly confidential.

**BOX J-501, THE OIL AND GAS JOURNAL,**
**TULSA, OKLAHOMA**

## PETROLEUM ENGINEERS

Graduate Petroleum Engineers with 2 - 8 years' experience wanted by Major Oil Company for work in Mid-Continent and Gulf Coast areas. Openings available for Reservoir and Field Production Engineers. In first reply give resumé of experience, date available, and salary expected.

**BOX J-479, THE OIL AND GAS JOURNAL,**
**TULSA, OKLAHOMA.**

## SALES REPRESENTATIVES WANTED:

Manufacturer of Oil-Gas Separating, Treating, Metering, and Automatic Lease Equipment wants commission Sales Representatives for (1) East Texas, Southern Arkansas, Northern Louisiana, (2) Texas Panhandle, (3) Williston Basin, (4) Illinois, Indiana, Kentucky, (5) Canada, (6) Mexico. Protected Territories available on exclusive Contract Basis to qualified and experienced men. Please give details concerning Sales Coverage, lines handled, and sales experience in first reply.

**BOX J-507,**
**THE OIL AND GAS JOURNAL,**
**TULSA, OKLAHOMA.**

## GENERAL MANAGER

Oil Field Equipment

Our company, a leader in oil field equipment and supplies, has an excellent opportunity open for a general manager. We are a growth company with annual sales of approximately $10,000,000.

To be qualified for this position, the right man should have some general management experience in his background. Preferred age is 40 to 50 years. Compensation will be approximately $30,000 plus stock option.

Your reply will be treated in strict confidence and should include age, present connection and home telephone number.

**Box J-532, The Oil and Gas Journal,**
**Tulsa, Oklahoma.**

HELP WANTED

SOUTH AMERICA. Major Oil Company. Our Fee paid. Engineers, all types, Drilling Production—Pipeline—Gas, B.S. Degree, no experience required. Tool Pushers, 3 to 5 years experience. Pipeline Mechanic, 5 years experience. Foreman Gas, 5 years experience. Career employment. Age to 40. All information confidential. Contact CHAS. J. LOVELESS PERSONNEL SERVICE, 616 South Main, Tulsa, Oklahoma—GIbson 7-3193.

**PETROLEUM ACCOUNTANT**

Practical accountant to handle office detail for an established independent oil producer. Knowledge of field operations, materials and where used will be helpful. Salary commensurate with experience and ability.

**CRAWFORD PRODUCTION COMPANY**
**316 Enterprise Building, Tulsa 3, Okla.**

## AREA ENGINEERS

Several graduate engineers with minimum 5 years' experience supervising maintenance engineering functions in oil refining or producing facilities, power plants, heavy industrial installations, manufacturing plants or related operations. To establish technical supervision, procedures, maintenance operations and schedule routine and special work for major oil producing and refining operation with all supporting facilities; i.e., housing, feeding, recreation, etc.

Salary commensurate with background and experience. Write giving full particulars regarding personal history and work experience. Please include telephone number.

***Recruiting Supervisor, Box 64***

**ARABIAN AMERICAN OIL COMPANY**
**505 PARK AVENUE**
**NEW YORK 22, NEW YORK**

## SAFETY ENGINEER

For modern, independent oil refinery located near St. Paul, Minnesota. He will report directly to the Plant Manager and be responsible for establishing and directing the safety policies and procedures for the operation and maintenance of the refinery, including a sound safety program, the procurement and maintenance of safety and fire fighting equipment, and coordination of plant design and safety.

A Bachelor of Science degree in Mechanical or Civil Engineering or equal with at least three years experience in oil refinery safety work required.

Furnish complete resume of experience and education, including salary requirements. All replies confidential. Write or apply in person:

**GREAT NORTHERN OIL COMPANY**
Pine Bend Refinery
P. O. Box 3596
St. Paul 1, Minnesota

HELP WANTED

JUNIOR GEOLOGIST or Paleontologist. Established petroleum consultant with sample laboratory in Cuba needs intelligent, aggressive, man for sample logging, surface mapping, surface work, etc. Salary $500.00 plus use of Jeep and field expenses. Bonus and one month yearly vacation. Opportunity for training and advancement. Please send complete application with college transcript, experience, references, knowledge of Spanish, draft status, etc. Harry Wassall, Consulting Geologist 202 Sinclair Building, Calle 21 y 0 Vedado, Havana, Cuba.

GEOLOGIST—Interesting position open with consulting firm of 26 years standing. Firm opening office in New Orleans and desires young ambitious, aggressive geologist having approximately 3 years South Louisiana experience. Man will staff office alone at present and will be required to maintain some regional maps, screen drilling prospects, initiate drilling prospects and do geology on consulting studies. Man must have initiative and be willing to work as work will be supervised by superiors located elsewhere who will not be constantly at hand. Salary open. Write giving age, experience and salary required. All replies confidential. Box J-519, The Oil and Gas Journal, Tulsa, Oklahoma.

**VALUATION ENGINEER**

Oil Company seeking to purchase producing oil properties desires services of petroleum engineer with experience in reservoir valuation and appraisal work. In addition to practical technical knowledge and experience, must have ability to make and develop contacts. Some experience in the ABC economics of financing purchases also desirable. This is a permanent salaried position with excellent opportunities for growth. Written reply should furnish details on education, experience, age, personal and professional references, and some idea of salary requirements. Small recent photo would be helpful.

Box J-528, The Oil and Gas Journal,
Tulsa, Oklahoma.

W

**PARTY CHIEFS**
**SEISMOLOGISTS**
**COMPUTERS**
**OBSERVERS**

**WORLD-WIDE SEISMOGRAPH CONTRACTING ORGANIZATION**

offers technical careers to qualified experienced applicants. Highly attractive starting salaries with good opportunities for advancement within both domestic and foreign areas.

**United Geophysical Corporation**
**POST OFFICE BOX "M"**
**PASADENA, CALIFORNIA**

## RESERVOIR ENGINEERS

**For reservoir studies, reserve estimation & development work on varied types active fields.**

EXCELLENT SALARY, ALLOWANCES, OPPORTUNITY OBTAIN ADDITIONAL EXPERIENCE & ADVANCEMENT.

***Positions Available Venezuela & Colombia. Graduate Engineers—minimum 3 years exp.***

Forward personal data, college transcripts, to:

C. L. LAUE

**SOCONY MOBIL**
OIL CO., INC.
26 Broadway, New York 4, New York

HELP WANTED

INDEPENDENT OIL OPERATOR needs geologist experienced in northeastern Oklahoma. Box J-529, The Oil and Gas Journal, Tulsa, Oklahoma.

**PETROLEUM ECONOMIST**

Integrated oil company desires experienced petroleum economist under 45 years of age to establish economics department in general office. Compensation and responsibilities commensurate with ability. Replies will be considered confidential. Forward resume to R. Paul Henry, Vice President.

**D-X SUNRAY OIL CO.**
**Box 381, Tulsa, Oklahoma**

**GEOLOGICAL SUPERVISOR**
**GEOLOGISTS**

Fully integrated major oil company has opening for geological supervisor with 8 to 10 years experience in exploration geology in the Rocky Mountain area. Also openings for graduate geologists. Replies should furnish complete personal data, education, experience and date available. All replies confidential.

**Box J-518, The Oil and Gas Journal, Tulsa, Oklahoma.**

## PETROLEUM ENGINEERS

Active independent oil company has vacancies for graduate petroleum engineers with two to five years of practical experience in drilling and production in West, West Central or North Texas. Excellent opportunities for growth and advancement. Replies should furnish complete personal data, education, experience, and starting salary desired.

BOX J-388,
THE OIL AND GAS JOURNAL,
TULSA, OKLAHOMA.

## FOREIGN EMPLOYMENT

**The Arabian American Oil Company has immediate job openings for unmarried males with minimum 5 years' experience in the following classifications:**

**BOILER FIREMAN**
High pressure boiler experience.

**TURBINE OPERATOR**
Electric power generation experience.

**ELECTRICIAN**
Heavy industrial construction and maintenance experience.

**MACHINIST**
Inside and outside experience.

**INSTRUMENT REPAIRMAN**
Oil refinery or chemical processing experience.

**CHEFS**
Large scale institutional, restaurant or construction camp experience.

***Write outlining personal history and work experience.***

***Recruiting Supervisor, Box 122***

**ARABIAN AMERICAN OIL COMPANY**
**505 PARK AVENUE**
**NEW YORK 22, NEW YORK**

### SITUATIONS WANTED

GEOPHYSICIST—ten years interpretation and field supervision. Desire position with oil company. Box J-503, The Oil and Gas Journal, Tulsa, Oklahoma.

ARE YOU INTERESTED in a Young, Aggressive man with technical and administrative abilities? Degrees in Chemical Engineering and Management. Experience in design and sales of gas processing equipment. Interested only in a good growth situation. Box J-510, The Oil and Gas Journal, Tulsa, Oklahoma.

QUALIFIED MAN of long experience and wide acquaintanceship in the Oil Industry, can represent Manufacturers of Oil Field and Oil Processing equipment on the Gulf Coast, New Orleans Area. If interested write to Box J-527, The Oil and Gas Journal, Tulsa, Oklahoma.

CPA, BBA, 34, FAMILY—diversified experience in public accounting, heavy in income taxes, top level oil accounting experience in production, pipe line, refinery, marketing, including LPG, seeks challenging position as Controller Assistant Controller, or Auditor. Available reasonable notice. Box J-533, The Oil and Gas Journal, Tulsa, Oklahoma.

EXECUTIVE—23 years practical experience in production and development work, last 13 years Central and Southern Oklahoma, desires position with active independent or small company on salary and interest basis. Box J-539, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOL. ADV. DEG.—16 years domestic, foreign, speak Spanish, prod., eng., drill. background, desires consultation retainer, part time employment, consider full time position, qualified handle land, geol., drill., prod. John O. Allen, 5816 N.W. 58th St., Oklahoma City.

### LEASE AND DRILLING BLOCKS

CONTACT A. L. BOWLES, Box 947, Ada, Okla., for Drilling Deals, Oil Production.

FOR SALE: Producing oil and gas wells and leases located in Garvin, Stephens, Kiowa Counties, Oklahoma. For details call or write, Ralph W. Shebester, Box 337, Pauls Valley, Oklahoma. Telephone 570.

FOR SALE—Two adjoining oil leases presently under water-flood operation, located in Cooke County, Texas, currently producing 70 barrels of oil per day, two sands behind pipe, engineering report available, excellent reserves, write 913 Brown Building, Austin, Texas, telephone GR 8-9498.

HAVE SHALLOW BLOCKS in Western Kentucky for sale, one semi-proven with 3 shallow pays 1050', 1250', 1600'. Contact D. C. Holman, 605 S. E. Riverside Drive, Evansville 13, Indiana.

LEASE 160 ACRES or more, LaCygne, Kan., 1500 feet of well just brought in Prue and Bartlesville sand. Owner L. O. MITCHELL, 3731 Euclid Ave., Kansas City, Mo.

**LEASES ROYALTIES**

**Producing and Nonproducing**
**Bought and Sold—Any Area**

**Inquiries Invited**

**B. D. BUCKLEY**
**6635 Delmar Ave., St. Louis, Mo.**

## Company Liquidating Properties

Oil and Gas Leases for Sale in Kiowa, Baca, Powers, and Cheyenne Counties, Colorado; Clark and Hamilton Counties, Kansas; Beaver, Cimarron, and Harper Counties, Oklahoma. Total acreage 7,950, full working interest, active lease play; excellent opportunity to get into areas under development. Details on request.

**Box J-516,**
**The Oil and Gas Journal,**
**Tulsa, Oklahoma.**

### ROYALTIES

HIGHEST PRICES PAID for choice oil and gas income royalties, overrides, oil properties. A. S. Berry, P. O. Box 1383, Tulsa, Oklahoma.

SPECIALIZING in Estate Liquidation of oil holdings—leases, producing or non-producing minerals, unlisted stocks, etc. Principals need not pay us any commissions. References furnished on request. Box J-400, The Oil and Gas Journal, Tulsa, Oklahoma.

PRODUCING ROYALTY For Sale: 1/128 of ⅞ override equal to 164 royalty acres on 3000 ac. So. Tex. lease has one recently completed gas-distillate well. Price $30 per royalty acre. Chas. H. Houston, Milam Bldg. San Antonio, Tex.

### SCOUTING

VENEZUELAN OIL SCOUTING AGENCY. Periodic reports—maps—newsletter. Mail: VOSA Apartado 3963, Caracas. Cables: VOSA, Caracas. Telephone 544802. Neal VanMiddlesworth.

### BUSINESS SERVICE

**Delaware Corporations formed and serviced. American Guaranty & Trust Company. P. O. Box 487, Wilmington, Delaware**

### BUSINESS OPPORTUNITIES

## PARTNER WANTED

Will option on easy terms a large interest in a successful geophysical business and the method which utilizes electronics, to an active, younger, ambitious man willing and able to show he possesses "take over" qualities. Success possibilities are limited only by your imagination and effort. Should have geologic or engineering training and ability to sell. All replies confidential.

Box J-538,
The Oil and Gas Journal,
Tulsa, Oklahoma.

**Petroleum Service Management Company, Inc.**

*Consulting Engineers and Geologists*

**Research, Evaluations, Bank Loan Reports, Investigations, Reports for Underwriting Issues, Well Supervision, Property Management, Contract Leasing, Drilling Deal Recommendations, Purchase of Proven Oil and Gas Properties. Complete management and supervision, U.S.A.-Foreign Refinery Design, Construction and Management. We handle all of your operations on straight retainer and management fee basis, or participating and retainer basis. 306 Commerce Building, Box 1992, Abilene, Texas. Phone 2-9621.**

*A Fresh Look at . . .*

## DELHI-TAYLOR OIL CORP.

*Copies of this study are available to interested investors.*

**THE KENTUCKY COMPANY**
**Fifth at Liberty Louisville 2, Ky.**

### MAILING LISTS

MAILING LISTS—Covering all branches oil industry. Free catalogue. Oil Industry Mailing List Co., 406 Tuloma Bldg., Tulsa, Okla.

### WANTED

VENTURE CAPITAL WANTED. Financing needed for oil drilling deals in Central Oklahoma. Also want contact with investors interested in acquiring oil properties. References furnished and required. Melco Drilling Co., Box 1360, Seminole, Oklahoma.

WANTED: Financial help to drill 100 acre lease, nine sands encountered to 1400 feet. Early Pennsylvania sand 250 feet deep, 550 feet best prospects. Wells pumping on joining lease. Atoka Co., Okla. Have Rig, Truck, Tools. Box J-537, The Oil and Gas Journal, Tulsa, Oklahoma.

**WANTED**

TO PURCHASE oil production or corporations having production for cash or stock in a listed company (or combination of both). All replies strictly confidential. Box J-412, The Oil and Gas Journal, Tulsa, Oklahoma.

## EXECUTIVE WANTED

Sales Engineer to become Sales Manager of well established rapidly growing Equipment Manufacturing Corporation (Automatic Lease Equipment) with outstanding immediate earning potential. Will require approximately $30,000 to purchase appreciable percentage of closed corporation stock. Must be graduate accredited Engineering College in Mechanical or Petroleum Engineering with minimum six years experience designing, manufacturing, or selling oil and gas production equipment. None others need apply. Must be aggressive, reliable. Will be required to furnish best of references. Give pertinent information in first reply. All replies confidential.

**Box J-504, The Oil and Gas Journal, Tulsa, Oklahoma.**

### ELECTRIC LOG CABINETS

FOR ECONOMICAL FILING of full-size electric logs, most geologists prefer Kraftbilt E-24 4-drawer cabinet. Two compartments to each drawer with separate follow blocks make this cabinet handy, economical. For filing reduced electric logs, geologists use Kraftbilt E-28 8-drawer cabinet. Send for new Catalog 1156-B. Ross-Martin Co., P. O. Box 800-A, Tulsa 1, Okla.

## Herb J. Hawthorne Names Thigpen and Williams

Jack W. Thigpen and E. L. Williams have been appointed area field-service engineers by Herb J. Hawthorne, Inc., Houston, manufacturer of Blue Demon replacable blade bits for seismic exploration, water-well and minerals-exploration drilling.

Thigpen, who will provide field-engineering service to Hawthorne customers in the Central-South Texas area, has been active in oil-field-engineering service since 1944, serving with Core Laboratory, Inc. until 1951. He then served with Core Analysis Service Co. before joining Hawthorne in field service.

Williams, representing Hawthorne in the East Texas-Gulf Coast area, has been in seismic exploration work since 1937 as a shot-hole driller with GSI, General Geophysical, and Gulf Oil Corp. before joining Hawthorne.

# ADVERTISERS IN THIS ISSUE


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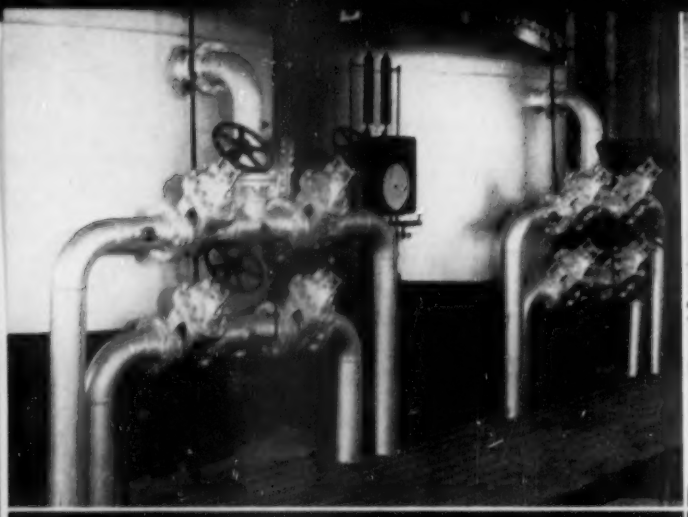

2-8′ x 5′ 40 PSI W.P. National Filters in Illinois Water Flood

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4-8′ x 5′ 60 PSI W.P. National Filters in gasoline plant near Schuler, Arkansas

8-75 PSI W.P. National Filters in Eastern Oklahoma Water Flood

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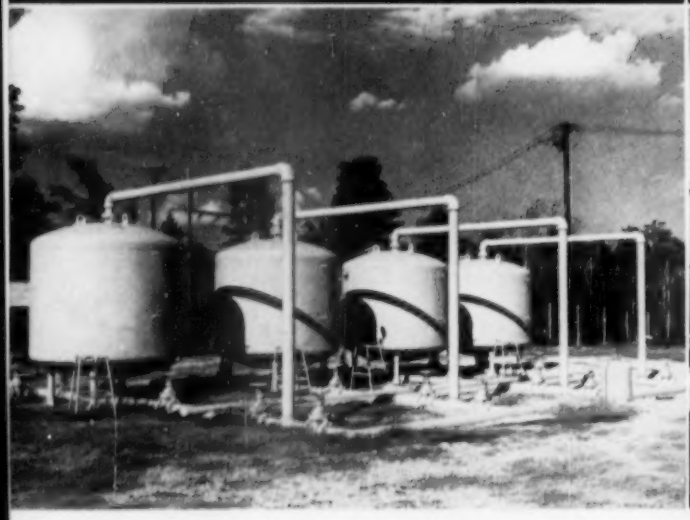
Battery of 200 PSI W.P. National Filters in West Texas Water Flood



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